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AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY

WITH INDEXES

Supplement 61

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ACCESSION NUMBER RANGES

Accession numbers cited in this Supplement fall within the
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STAR (N- 10000 Series)   N75-23470 — N75-25862

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AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 61

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in August 1975 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA)*

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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering The first issue of this bibliography was published in September 1970 and the first supplement in January 1971 Since that time, monthly supplements have been issued

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 418 reports, journal articles, and other documents originally announced in August 1975 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries*, in that order The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals This procedure, which saves time and money, accounts for the slight variation in citation appearances

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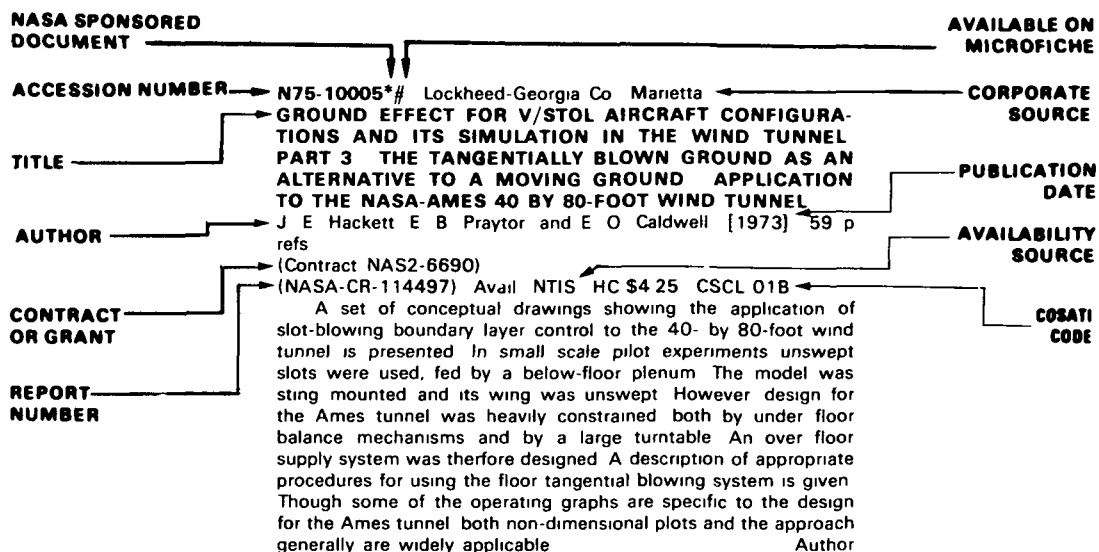345 Middlefield Road
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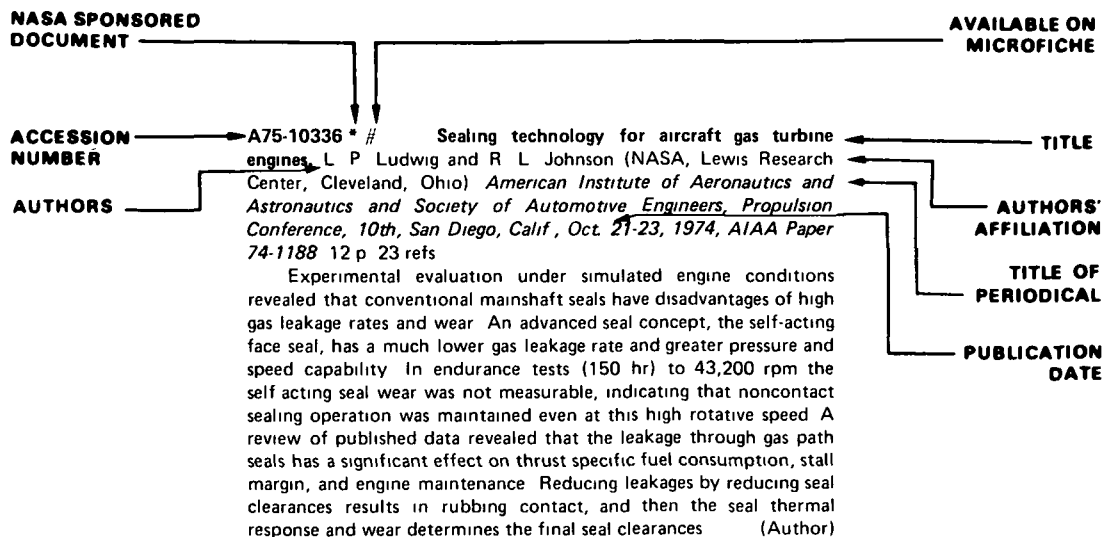8 Munchen 86
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GROUND EFFECT FOR V/STOL AIRCRAFT CONFIGURA-
TIONS AND ITS SIMULATION IN THE WIND TUNNEL

TITLE — PART 3 THE TANGENTIALLY BLOWN GROUND AS AN
ALTERNATIVE TO A MOVING GROUND APPLICATION
TO THE NASA-AMES 40 BY 80-FOOT WIND TUNNEL

PUBLICATION
DATE

AUTHOR — J E Hackett E B Praytor and E O Caldwell [1973] 59 p
refs

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COSATI
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A set of conceptual drawings showing the application of
slot-blowing boundary layer control to the 40- by 80-foot wind
tunnel is presented In small scale pilot experiments unswept
slots were used, fed by a below-floor plenum The model was

REPORT — sting mounted and its wing was unswept However design for
NUMBER the Ames tunnel was heavily constrained both by under floor
balance mechanisms and by a large turntable An over floor
supply system was therfore designed A description of appropriate
procedures for using the floor tangential blowing system is given
Though some of the operating graphs are specific to the design
for the Ames tunnel both non-dimensional plots and the approach
generally are widely applicable   Author

TYPICAL CITATION AND ABSTRACT FROM *IAA*

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ACCESSION → A75-10336 * # Sealing technology for aircraft gas turbine ←
NUMBER engines, L P Ludwig and R L Johnson (NASA, Lewis Research ←

TITLE

Center, Cleveland, Ohio) *American Institute of Aeronautics and*

AUTHORS — *Astronautics and Society of Automotive Engineers, Propulsion*
Conference, 10th, San Diego, Calif, Oct. 21-23, 1974, AIAA Paper
74-1188 12 p 23 refs

AUTHORS'
AFFILIATION

TITLE OF
PERIODICAL

Experimental evaluation under simulated engine conditions
revealed that conventional mainshaft seals have disadvantages of high
gas leakage rates and wear An advanced seal concept, the self-acting

PUBLICATION
DATE

face seal, has a much lower gas leakage rate and greater pressure and
speed capability In endurance tests (150 hr) to 43,200 rpm the
self acting seal wear was not measurable, indicating that noncontact
sealing operation was maintained even at this high rotative speed A
review of published data revealed that the leakage through gas path
seals has a significant effect on thrust specific fuel consumption, stall
margin, and engine maintenance Reducing leakages by reducing seal
clearances results in rubbing contact, and then the seal thermal
response and wear determines the final seal clearances   (Author)

IAA ENTRIES

A75-32396 **Automatic Test System for Jet Engine Accessories** R Hartwell (RCA, Government Communications and Automated Systems Div, Burlington, Mass) *RCA Engineer,* vol 20, Apr May 1975, p 30-35

The present work describes the design concepts of the Automatic Test System for Jet Engine Accessories (ATSJEA), a fully automated test facility for a wide range of jet aircraft fuel controls, pumps, and similar accessories The test stands, in which hydraulic and pneumatic flows and pressures, mechanical rotations, and physical linkages are the principal quantities sensed, are connected via an elementary operations controller (EOC) to the CPU and computer peripheral equipment Test programs written in FORTRAN IV control, measure, record, sequence, and evaluate individual tests   P T H

A75-32397 **Automated test facility for aircraft hydraulic pumps and motors** R Blanchard and L R Hulls (RCA, Government Communications and Automated Systems Div, Burlington, Mass) *RCA Engineer,* vol 20, Apr May 1975, p 36 39

A multi-stand test facility is described which automatically tests aircraft hydraulic pumps and motors in their three basic configurations A central hydraulic supply is employed, consisting of an assembly of pumps which share the load in delivering fluid under pressure to a common supply manifold, reducing the number of motors, pumps, and heat exchangers The system features pump and starter stands plus combined pump/motor and motor/starter test stands A computer identified as an elementary operations controller interfaces the central processor unit to a group of ten test stands Particular consideration has been given to energy conservation in the design of the system   P T H

A75-32410 **Velocity vector The logical solution** J E Hutchinson *Shell Aviation News,* no 427, 1975, p 6-10

A description is given of two head up aircraft displays produced by Thomson-CSF, the CV-91 visual guidance system and the TC 121 all-weather approach and landing monitor The basic information presented to the pilot includes the velocity vector, the potential path, the aircraft symbol, the reference angle of attack, and the flight path Flight evaluations show that in visual approaches, the CV 91 enables any desired glide path angle to be flown precisely without ground-based guidance such as ILS or VASI The TC-121 provides the capability of monitoring an automatic approach and landing, with the pilot able to take over manually at any point   A T S

A75-32430 **Random vortex shedding noise of airfoils** S Kotake (Tokyo, University, Tokyo, Japan) *Journal of Sound and Vibration,* vol 40, May 8, 1975, p 87 99 6 refs

The acoustic radiation due to turbulent vortex shedding from a thin airfoil is analyzed by applying thin airfoil theory In terms of the statistical quantities of the wake vorticity that is, the spanwise and chordwise intensities of turbulent vorticities or turbulent circulations per unit length and their space and time correlations the associated acoustic intensity is expressed The latter spectral density distribution can be related to that of the wake vortices through their inertial modification   (Author)

A75-32439 **Search for the final period of decay of the axisymmetric turbulent wake** P Freymuth (Colorado, University, Boulder, Colo) *Journal of Fluid Mechanics,* vol 68, Apr 29, 1975, p 813-829 19 refs

Profiles of mean and fluctuating turbulent velocities and temperatures, of the time derivative of velocity and of intermittency have been measured in the wake of an unheated as well as a heated sphere in the low Reynolds number range 600-2500 at distances 80-1800 sphere diameters downstream The wind-tunnel experiments exhibit a strong dependence on Reynolds number but they do not indicate the attainment of or an approach to the final period of turbulent decay which has been explored theoretically by Phillips and by O'Brien The lowest turbulence Reynolds number obtained was R sub lambda = 1 4   (Author)

A75 32452 *#* **On the way to tactical aircraft robotics** W B Ballenberger (Sperry Rand Corp, Sperry Flight Systems Div, Phoenix, Ariz) *Astronautics and Aeronautics,* vol 13, June 1975, p 28-35

A radar control system for the F 102A aircraft is described The PQM 102 target system, as it is designated, features a dual redundant (two sets of radar and controls) mobile ground station, a fixed ground station, and two fixed ground radar sources The primary radar of the mobile ground station has a 50 n mi range and a 2 kW output, it controls the plane during takeoff and recovery and during close-in missions The aircraft contains a 7 5 lb rod charge for destruct purposes and a scoring system consisting of four antenna assemblies containing two independent receiving elements, one horizontally and the other vertically polarized Applications envisioned for the target system include interdiction, surveillance, reconnaissance, ECM, decoy, defense suppression, and air superiority   S J M

A75-32455 *#* **B-1 - The road to first flight** A B Martin (USAF, Systems Command, Wright Patterson AFB, Ohio) *Astronautics and Aeronautics,* vol 13, June 1975, p 56-62

The present article provides insight into the complexity of present aircraft weapons systems and demonstrates how extensive

'test before fly' must help neutralize the risk associated with this complexity and insure a successful 'fly before buy' Specifically, the complexity and preflight testing of the B-1 are reviewed Component materials and structural features of this aircraft were emphasized in the testing process   S J M

A75-32463   Mechanics of composite materials R M Jones (Southern Methodist University, Dallas, Tex) Washington, D C, Scripta Book Co, 1975 367 p 176 refs $21 50

The classification and the characteristics of composite materials are considered along with a basic terminology of laminated fiber-reinforced composite materials, the manufacture of laminated fiber-reinforced composite materials, and current and potential advantages of fiber reinforced composite materials Attention is given to the macromechanical behavior of a lamina, the micromechanical behavior of a lamina, the macromechanical behavior of a laminate, and the bending, buckling, and vibration of laminated plates Other topics discussed are related to fatigue, holes in laminates, and aspects of fracture mechanics   G R

A75-32468 #   A method to determine a distribution function of main structure failures in an aircraft M Samir Abdelsalam *Zprava VZLU*, Z-23, 1974, p 1-9 6 refs

An approach is suggested for determining the structural distribution function of main defects in fatigue-tested structures of an aircraft Only one representative structure is tested, and it is assumed that in the recorded sequence of defects, all defects will manifest the same distribution function type, so that the method is actually based on the formalism of a partially parallel system Any quantile of the distribution function of the main defects can then be graphically or numerically determined The method is tested by solving the distribution function for the first main defect of the Ae 45 aircraft frame under fatigue strength testing and comparing the theoretical solution with measurement data on the actually determined distribution function   P T H

A75-32470 #   Diagnostics of jet aero-engines by means of spectral analysis of lubricating oil (Diagnostika leteckych reaktivnich motoru pomoci spektralni analyzy oleje) P Vacek *Zpravodaj VZLU*, no 4, 1974, p 15, 16 5 refs In Czech

A method of interpreting the results of spectral analysis of lubricating oil, which is used as one of the principal methods of diagnosis of the condition of aero engines, is described This method is based on the rate of change of concentration of the products of wear in lubricating oil, which is proportional to the rate of wear of the lubricated parts This method makes it possible to determine the critical points in respect to wear and so detect and eventually prevent failures of aero engines in operation   (Author)

A75-32471 #   Statistical analysis of the functioning quality of regulators with random parameter scatter (Prispevek ke statisticke analyze jakosti prace regulatoru s nahodnym rozptylem parametru) M T A El-Mayah *Zpravodaj VZLU*, no 5, 1974, p 5-16 12 refs In Czech

The author points out three methods The analytical method is suitable for a small number of parameters and the simplest forms of distribution For solving this task the author goes over to a linearized form of the criterial function and to the simplest distributions The second method is combined numerical-analytical, in which the random changes of parameters are simulated numerically, but the magnitudes of the criteria are calculated from the known analytical formula The obtained population of random realizations of the criterial function are processed by usual statistical methods The purely numerical method can be used even for complicated and nonlinear systems, but it requires comparatively much machine time As an example the system of a single shaft gas generator and a hydraulic mechanical regulator is solved   (Author)

A75-32472 #   Transmissivity of light - One of the quantities usable in the diagnostics of oil in a motor (Propustnost svetla - Jedna z velicin vyuzitelnych pro diagnostiku oleje v motoru) J Krotky *Zpravodaj VZLU*, no 5, 1974, p 17-21 7 refs In Czech

A method is described for measuring the transmissivity of fresh B3V oil and of oil of different degrees of use The relationship between transmissivity and degradation of oil used in a turboprop engine is determined It is found that transmissivity is a function of oil loading Measurement of transmissivity can therefore be used as a means of determining the state of the oil directly in the engine   P T H

A75-32473 #   Identification of systems by means of adaptive model (Identifikace systemu pomoci adaptivniho modelu) J Salaba *Zpravodaj VZLU*, no 6, 1974, p 5-14 20 refs In Czech

Methods of identifying systems are reviewed and evaluated, and a method based on the use of adaptive models is then analyzed This method features three variants for coupling the models series, series-parallel, and parallel Analysis and derivation of identification by means of the adaptive model are given for the case when the set of state variables measured in the system is known Possibilities for application of the method of identification with an adaptive model to a jet engine and its modifications are examined   P T H

A75-32518 #   The problem of diffraction of a strong magnetogasdynamic shock wave by a wedge (Zadacha o difraktsii sil'noi magnitogazodinamicheskoi udarnoi volny okolo klina) L D Azatian (Erevanskii Gosudarstvennyi Universitet, Yerevan, Armenian SSR) *Akademiia Nauk Armianskoi SSR, Izvestiia, Mekhanika*, vol 27, no 5, 1974, p 47 62 17 refs In Russian

The nonuniform flow region is investigated in the problem of the reflection of a strong magnetogasdynamic shock wave from a wedge with an obtuse angle (close to 180 deg) in the presence of a magnetic field parallel to the incident wave The Smirnov Sobolev method is used to reduce this problem to a boundary problem for the solution of an analytical function characterizing the pressure involved The solution is obtained by the Lighthill method The gas parameters behind a shock wave incident on the obtuse wedge and behind a plane wave reflected from the wedge are determined, along with the pressure distribution over the wedge wall   S D

A75-32527 #   Rescue measures in the case of accidents of the AN-12 aircraft (Spasatel'nye meropriiatiia pri avarii samoleta AN-12) G A Kas'ianov and G M Shereshkov *Voenno Meditsinskii Zhurnal*, Mar 1975, p 57 60 In Russian

An emergency rescue procedure for accidents involving the AN-12 aircraft is described The proposed procedure makes use of stretchers, straps, parachute harness, and a special ambulance car The characteristics of each of the available emergency hatches are taken into consideration The evacuation of casualties is discussed in terms of penetration into the aircraft and evacuation of casualties directly from their posts or out of the aircraft cabins   S D

A75-32652 #   Response of aircraft structural compartments to blast pressures and fragments from high explosive projectiles M J Jacobson, J R Yamane, and J Brass (Northrop Corp, Hawthorne, Calif) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo, May 27-29, 1975, AIAA Paper 75-751* 8 p 21 refs Research supported by the Northrop Corp, Contract No F33615 72 C 1045

A description is given of the BR-1 (Blast Response) finite element computer code that was developed to predict the local damage and transient response of metallic aircraft structural compartments subjected to blast pressures and fragments from the detonation of high explosive (HE) projectiles within the compartment The structural analysis is limited to isotropic materials and

unstiffened or skin-rib-stringer type construction Large deflections, large strains, nonlinear stress-strain relations, and ultimate strain material failures are accounted for in the structural response theory that was assembled in the development of the BR 1 code Sample problems of structural response to blast loading that were executed with the BR-1 code are discussed, and the prominent role of the membrane stresses in the response is noted   (Author)

A75-32654 * #   Applications of a quadratic extended interior penalty function for structural optimization R T Haftka (Technion - Israel Institute of Technology, Haifa, Israel) and J H Starnes, Jr (NASA, Langley Research Center, Structures and Dynamics Div, Hampton, Va) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo, May 27-29, 1975, AIAA Paper 75-764* 11 p 11 refs Grant No NGR-52 012-008

A quadratic extended interior penalty function formulation especially well suited for second order unconstrained optimization procedures is presented Analytical derivatives of constraints and an approximate analysis technique are used Minimum-mass design results are presented which indicate that the combination of these procedures can help make mathematical programming a useful optimization tool for large order structural design problems with a large number of design variables and multiple constraints Examples include statically loaded high- and low aspect ratio wings simultaneously subjected to stress, displacement, minimum gage and, in some cases, maximum strain constraints   (Author)

A75-32656 * #   Stochastic model for fatigue crack size and cost effective design decisions S Hanagud (Georgia Institute of Technology, Atlanta, Ga) and B Uppaluri *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo, May 27-29, 1975, AIAA Paper 75-766* 10 p 16 refs Grant No NGR 11 002-169, Contract No NAS8 30617

This paper describes a methodology for making cost effective fatigue design decisions The methodology is based on a probabilistic model for the stochastic process of fatigue crack growth with time The development of a particular model for the stochastic process is also discussed in the paper The model is based on the assumption of continuous time and discrete space of crack lengths Statistical decision theory and the developed probabilistic model are used to develop the procedure for making fatigue design decisions on the basis of minimum expected cost or risk function and reliability bounds Selections of initial flaw size distribution, NDT, repair threshold crack lengths, and inspection intervals are discussed   (Author)

A75-32657 * #   Statistical estimation of service cracks and maintenance cost for aircraft structures J N Yang (Virginia Polytechnic Institute of State University, Blacksburg, Va) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo, May 27 29, 1975, AIAA Paper 75 767* 11 p 20 refs Grant No NsG 1099

A method is developed for the statistical estimation of the number of cracks to be repaired in service as well as the repair and the maintenance costs The present approach accounts for the statistical distribution of the initial crack size, the statistical nature of the NDI technique used for detecting the crack, and the renewal process for the crack propagation of repaired cracks The mean and the standard deviation of the cumulative number of cracks to be repaired are computed as a function of service time The statistics of the costs of repair and maintenance, expressed in terms of the percentage of the cost of replacement, are estimated as a function of service time The results of the present study provide relevant information for the decision of fleet management, the estimation of life cycle cost, and procurement specifications The present study is essential to the design and cost optimization of aircraft structures   (Author)

A75-32662 #   Drag effects on wing flutter A Petre (Bucu resti, Institutul Politehnic Gheorghe Gheorghiu Dej, Bucharest, Rumania) and H Ashley (Stanford University, Stanford, Calif) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver Colo, May 27-29, 1975, AIAA Paper 75-775* 11 p 7 refs NSF Grant No GK-35004, Grant No AF AFOSR-74-2712

An investigation is conducted of the influence of drag on dynamic aeroelastic stability, taking into account the large-aspect-ratio straight wing as a model The investigation makes use of the method of fixed directions The wing is an unswept cantilever of constant cross section Strip theory for incompressible unsteady flow is adopted as a source of loads in the lift direction Drag is assumed to have invariant direction and magnitude all across the span   G R

A75-32663 #   The random decrement technique applied to the YF-16 flight flutter tests W J Brignac, H B Ness, and L M Smith (General Dynamics Corp, Fort Worth, Tex) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo, May 27-29, 1975, AIAA Paper 75 776* 9 p 7 refs

The application of the random decrement method to flight flutter testing of the YF 16 lightweight fighter prototype is described The method was adopted to simplify and shorten the flutter clearance procedure In this approach, subcritical damping of the structural modes is extracted from the turbulence-induced random vibrations of the structure Hence, the method bypasses the requirement for an excitation system needed in the conventional approaches Damping is obtained from the Randomdec Signature of each mode The Randomdec Signature is analogous to the transient response to an initial displacement To obtain a Randomdec Signature, one collects and averages a number of segments of the random response of the mode   (Author)

A75 32664 #   Minimum weight design of the F 15 empennage for flutter J D Shelton and P B Tucker (McDonnell Aircraft Co, St Louis, Mo) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo, May 27 29, 1975, AIAA Paper 75 777* 10 p 6 refs

The twin boom F 15 empennage was found to be a complex dynamical system and considerable effort was devoted to the evaluation of alternate methods for achieving a flutter free configuration To obtain a minimum weight low drag design, the stiffness properties of the boron composite lifting surfaces were tailored, boron composite skins were used on the rudders, vertical tail tip pod balance weights were added, and the inboard leading edge of the stabilators was snagged The program for the design and flutter substantiation of the F 15 empennage is summarized and significant results of analytical flutter studies and wind tunnel flutter model test data that affected the empennage design are presented   (Author)

A75-32667 * #   Influence of structural damping, preconing offsets and large deflection on the flap-lag-torsional stability of a cantilevered rotor blade P Friedmann (California, University, Los Angeles, Calif) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo, May 27 29, 1975, AIAA Paper 75-780* 14 p 12 refs Army-supported research, Grant No NGR-05-007-414

A set of equations describing the coupled flap-lag-torsional dynamics of a cantilevered rotor blade in hover is presented This set of equations is used to evaluate the influence of structural damping, preconing and offsets on the linearized aeroelastic stability of some representative blade configurations A number of examples illustrating the coupled nonlinear flap-lag-torsional response are considered   (Author)

A75-32668 # New Air Force requirements for structural safety, durability and life management M D Coffin (USAF, Aeronautical Systems Div , Wright Patterson AFB, Ohio) and C F Tiffany *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo , May 27 29, 1975, AIAA Paper 75-781* 8 p 8 refs

The past five years have seen significant changes in the Air Force philosophy and approach in achieving structural safety and durability in military aircraft These changes have been motivated by problems of high cost, late system development programs, with a high level of in-service structural maintenance and modification costs (poor durability) and, in some cases, less than desired fracture resistance (poor damage, tolerance/safety) The problem area has been attacked along a number of avenues, one major thrust has been a thorough examination and revision of the structural design and test specifica tions, the MIL A-8860 series In this paper certain aspects of the overall problem are discussed An overview of the pre-1969/70 Air Force approach is presented along with its shortcomings, and, finally, significant aspects of current policy are listed giving comparisons with the old requirements (Author)

A75-32670 * # Hypersonic wing test structure design, anal ysis, and fabrication P P Plank (Martin Marietta Aerospace, Denver, Colo) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo , May 27-29, 1975, AIAA Paper 75 785* 12 p Contract No NAS4 1845

An investigation was conducted to provide the analyses, data, and hardware required to experimentally validate the beaded panel concept and demonstrate its usefulness as a basis for design of a hypersonic research airplane (HRA) Combinations of beaded panel structure, heat shields, channel caps, and corrugated webs for ribs and spars were analyzed for the wing of a specified HRA to operate at Mach 8 with a life span of 150 flights Detailed analyses, conducted in accordance with established design criteria, included aerodynamic heating and load predictions, transient structural thermal calculations, extensive NASTRAN computer modeling, and structural optimization After geometry was established for the total wing, part of the wing (85 sq ft) was designed, fabricated, and assembled into a test structure to experimentally verify the structural adequacy of the beaded panel design concept (Author)

A75-32673 * # Impact fracture of composite sandwich struc tures M D Rhodes (NASA, Langley Research Center, Hampton, Va) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo , May 27-29, 1975, AIAA Paper 75-748* 10 p 12 refs

An experimental investigation of impact initiated failures in high strength graphite/epoxy and Kevlar-49/epoxy sandwich struc tures has been conducted The tests consisted of firing small diameter aluminum projectiles with a velocity range of 16 67 meters/second (52 220 ft/sec) at preloaded sandwich specimens These tests were intended to be representative of service conditions on materials and structures which might be used as secondary aircraft components The preload and impact energy necessary to initiate catastrophic failure were determined The residual strength of impact damaged specimens was also measured The results of these tests indicate that catastrophic failures in sandwich structures can be initiated at relatively low preloads by impact projectiles at energy levels well below that required to initiate visible damage (Author)

A75-32675 # Development and testing under static condi tions of a B-Al load transfer element R Gunther and W Hartmann (Messerschmitt-Bolkow-Blohm GmbH, Ottobrunn, West Germany) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo , May 27-29, 1975, AIAA Paper 75-788* 15 p Research sponsored by the Bundesministerium der Verteidigung of West Germany

High strength aircraft structures can be manufactured from boron fiber reinforced aluminum (B Al) B-Al structural components, including a load transfer element, have been manufactured and tested The load transfer element consists of fan shaped B-Al corrugated webs joined to B-Al cover sheets of varying thickness

Force applied at a point can be distributed over a large area By using appropriate cross and angle ply orientations one can use B Al's inherently excellent strength and stiffness to the full Special attention was directed to calculating the B Al web dimensions and their fixture to the cover sheets The finished element incorporates two basic substructures The corrugated webs are obtained by braze bonding tapes, the laminated cover sheets are made by using a mask in order to obtain the required varying cross sections during the braze bonding process (Author)

A75-32680 # Ion vapor deposited aluminum improves struc ture durability E R Fannin and K E Steube (McDonnell Aircraft Co , St Louis, Mo) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo , May 27-29, 1975, AIAA Paper 75-807* 6 p 5 refs

Two fairly recent changes in airframe structure have had an impact on the corrosion protective coatings used First, the fatigue improvements resulting from the use of interference fit fasteners can be greatly reduced if anodic coatings are applied to the aluminum structure The second change involves the increased utilization of titanium structure which places a restriction on the use of cadmium plating because of potential solid metal embrittlement Data is presented to show that ion vapor deposited aluminum coatings can be substituted for both of the above coatings without these undesirable effects Additional performance comparisons of the aluminum coating will also be described (Author)

A75-32684 # Crippling/column buckling analysis and test of graphite/epoxy stiffened panels E E Spier (General Dynamics Corp , Convair Div , San Diego, Calif) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo , May 27-29, 1975, AIAA Paper 75-753* 17 p 6 refs

This paper is concerned with test and analysis of graphite/epoxy stiffened panels Both wide-column and local crippling tests were involved, where conventional aircraft strength of materials tech niques, in conjunction with lamination theory, were employed in the analysis Stiffener cross sections include both rectangular and I section shapes Although catastrophic delaminations usually occur at failure, theoretical predictions of crippling and wide column strengths agree remarkably well with the test results The test panels have potted end supports, providing nearly clamped-end conditions in the testing machine Slenderness ratios were carefully selected to provide either a crippling specimen or a moderate length column as required The stiffened panels were Type A-S/3501 graphite/epoxy with cocured stiffeners The skins were pseudoisotropic laminates, while several laminations were selected for elements of the stiffeners The results of this paper have demonstrated good potential for graphite/epoxy structures in primary components of aircraft and spacecraft (Author)

A75-32688 * # Analytical displacements and vibrations of cantilevered unsymmetric fiber composite laminates M D Minich and C C Chamis (NASA, Lewis Research Center, Cleveland, Ohio) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo , May 27-29, 1975, AIAA Paper 75-757* 13 p 6 refs

A fiber composite flat cantilever plate that has symmetric and nonsymmetric laminate configurations is theoretically investigated to determine its static and dynamic structural response The finite element analysis method used includes a unique triangular finite element developed at Lewis for the analysis of fiber composite airfoils The various responses investigated include tip displacements, natural frequencies, and fundamental mode shapes The results show that laminate configurations may be selected for a cantilever such that when the tip at the leading edge is loaded normal to the plane of the plate, the tip at the trailing edge can (1) deflect in the opposite direction, (2) deflect about the same, or (3) deflect more than the tip at the leading edge This variation in response can be utilized to provide built in structural damping to resist flutter (Author)

A75-32689 # Subsonic transient lifting surface aerodynamics T B Burkhart (McDonnell Douglas Corp , St Louis, Mo) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo , May 27-29, 1975, AIAA Paper 75-758* 10 p 15 refs

A method is presented for numerical evaluation of subsonic transient lifting surface aerodynamics Existing subsonic oscillatory aerodynamic procedures are modified to evaluate generalized aerodynamic factors as two matrices aerodynamic stiffness and damping Transfer functions are numerically evaluated which describe the complex variation with reduced frequency of each matrix element The results are used to formulate the aeroelastic equations of motion in the Laplace operator and real time domains The Laplace operator formulation is applied to transient flutter solutions and the results compared to conventional solutions The time formulation is applied to several time history dynamic response configurations (Author)

A75-32690 # The flutter analysis of T tails W P Jennings and M A Berry (Boeing Co , Seattle, Wash) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo , May 27 29, 1975, AIAA Paper 75 759* 5 p 7 refs

The importance of stabilizer dihedral and static lift forces on T-tail flutter speeds is discussed Based upon strip theory considerations the additional unsteady aerodynamic forces derived from these static forces are introduced into the generalized air forces of the system The importance and introduction of structural deformations caused by such static forces are also considered These effects are confirmed by the results of flutter tests on a low speed flutter model (Author)

A75-32691 # The supersonic doublet lattice method - A comparison of two approaches B J Brock and J A Griffin, Jr (LTV Aerospace Corp , Dallas, Tex) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo , May 27-29, 1975, AIAA Paper 75-760* 8 p

The method described is based on a relatively simple form of the kernel function for supersonic flow Techniques are presented for evaluating the required integrals of the kernel function with its singularities for the coplanar condition Certain difficulties in the application of the supersonic doublet lattice method have been overcome by developing an approach based on rectangular panels mapped into squares An approach utilizing a doublet Mach box is compared with the doublet lattice method G R

A75-32692 # Oscillatory supersonic lifting surface theory using a finite element doublet representation J P Giesing and T P Kalman (Douglas Aircraft Co , Long Beach, Calif) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo , May 27-29, 1975, AIAA Paper 75-761* 18 p 18 refs Research supported by the Douglas Aircraft Co

A new method for predicting oscillatory supersonic lifting surface airloads has been developed which is based on a finite element doublet representation The finite elements are both swept and tapered and thus are able to fit most planforms accurately Diaphragm regions are eliminated because of the doublet representation and the procedure is applicable to very general nonplanar configurations As a first step in the development of this procedure the present paper gives the theory and results for the planar case Subsonic and supersonic leading or trailing edges are considered In addition, control surface and wing tail interaction cases are also considered (Author)

A75-32693 * # Integrated potential formulation of unsteady supersonic aerodynamics for interacting wings K Appa (Bell Aerospace Co , Buffalo, N Y) and W P Jones (Texas A & M University, College Station, Tex) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo , May 27-29, 1975, AIAA Paper 75-762* 14 p 40 refs Contract No NAS1 12709

A numerical integrated velocity potential method for the determination of unsteady aerodynamic forces on arbitrary interacting wings and tails in supersonic flow has been developed Constant Mach number has been assumed throughout the flow field Normalwash and sidewash integrals have been derived The upwash integral remains to be derived Singular integrals in the expressions for the velocity components have been evaluated in closed form Lifting surfaces are represented by triangular elements defined by arbitrarily spaced characteristic lines and the true surface edges The wake field is represented by rectangular strip elements Velocity potential distributions and generalized aerodynamic coefficients have been compared (Author)

A75-32694 # Interaction between control augmentation system and airframe dynamics on the YF-17 T D Arthurs and J T Gallagher (Northrop Corp , Hawthorne, Calif) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo , May 27-29, 1975, AIAA Paper 75-824* 10 p 5 refs

Three types of instability, involving interaction between control augmentation system (CAS) and airframe dynamics, were identified during development of the YF 17 air combat fighter Two were potential flight instabilities the first in which the CAS coupled with rigid airframe dynamics, the second involving coupling with elastic structural dynamics The third type was the ground instability generally referred to as ground resonance This paper describes the analytical and test methods used to define feedback compensation required to suppress adverse coupling and permit CAS operation at design gain levels All three types of instability were found to be predictable using a unified analytical approach and no unanticipated interaction was encountered during the flight program Recommendations are made for the use of improved analogs of airframe response in ground limit cycle tests (Author)

A75 32695 # YF16 active control-system/structural dynamics interaction instability R P Peloubet, Jr (General Dynamics Corp , Fort Worth, Tex) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo , May 27 29, 1975, AIAA Paper 75-823* 16 p 11 refs

During the early flight tests of the YF16 an instability was encountered involving antisymmetric oscillations of the airplane at a frequency of 6 5 Hz Subsequent analyses coupling flexible airplane dynamics and the active flight control system were conducted for flight conditions at which the instability had been observed Antisymmetric natural modes of vibration measured during the ground vibration tests were used as degrees of freedom as well as the antisymmetric rigid body degrees of freedom The Nyquist criteria was employed to determine stability of the system in the frequency domain The analyses indicated that the instability was caused by a coupling of the flight control system and the vibration modes of the airplane The degree of correlation between analysis and flight test is shown (Author)

A75 32697 * # Active flutter suppression using trailing edge and tab control surfaces E Nissim (Technion - Israel Institute of Technology, Haifa, Israel) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo , May 27 29, 1975, AIAA Paper 75-822* 8 p Grant No NsG 7072

An optimization procedure, based on the Aerodynamic Energy concept, is applied to the problem of flutter suppression using trailing edge (T E) and tab control surfaces A control law is assumed which allows the T E -Tab system to be driven by both

linear and rotational sensors, and the optimum control law param
eters are determined Results are presented which indicate the
capability of the T E Tab control system to suppress flutter A
comparison is also made between the T E Tab and the leading edge
(L E) T E control systems which shows their relative effectiveness
together with some aspects connected to the realization of the
control law (Author)

A75-32701 * # Evaluation of bead-stiffened metal panels J
L Shideler, H L Bohon (NASA, Langley Research Center,
Structures and Dynamics Div , Hampton, Va), and B E Greene
(Boeing Aerospace Co , Seattle, Wash) *AIAA, ASME, and SAE,
Structures, Structural Dynamics, and Materials Conference, 16th,
Denver, Colo , May 27-29, 1975, AIAA Paper 75-815* 9 p 15 refs

Potential weight efficiency for bead-stiffened panels has been
demonstrated through fabrication and testing Theoretically opti-
mum design concepts were identified, and small specimens were
tested under combined compression, shear, and bending to determine
local buckling failure loads and to verify theory Large optimized
panels were then designed and tested under combined loads
Correlation of test data for large circular tubular panels with theory
was conservative and consistent, and indicated reliable and accept-
able design theory Tests of fluted tubular panels indicated general
instability failures at loads far below the design values due to
nonlinear distortions Further study of the fluted tubular configura-
tion will be required if its potential weight efficiency is to be
attained (Author)

A75-32705 # System identification of a complex structure
A Berman (Kaman Aerospace Corp , Bloomfield, Conn) *AIAA,
ASME, and SAE, Structures, Structural Dynamics, and Materials
Conference, 16th, Denver, Colo , May 27-29, 1975, AIAA Paper
75-809* 7 p 6 refs Grant No DAAJ02-74 C-0039

The method of incomplete models has been extended and used
to obtain dynamic equations of motion of a helicopter transmission
gearbox from shake test data The application resulted in a valid
analytical model covering a frequency range to 3000 Hertz and
encompassing approximately twenty major normal modes The
model is usable for component synthesis analyses and for the study
of effects of boundary conditions and structural changes The paper
demonstrates a simple and inexpensive procedure compared to a
conventional finite element analysis and its use is recommended
where such analyses are uneconomical or impractical and where
hardware exists (Author)

A75-32706 *l* Vibration analysis of multi symmetric struc
tures D A Evensen (TRW Systems Group, Redondo Beach, Calif)
*AIAA, ASME, and SAE, Structures, Structural Dynamics, and
Materials Conference, 16th, Denver, Colo , May 27-29, 1975, AIAA
Paper 75 808* 15 p 16 refs

This paper demonstrates that for multi symmetric structures,
symmetry concepts can be used to reduce the size of the eigenvalue
problem which must be modelled and solved using a discrete
formulation It also demonstrates that an understanding of group
theory can be used to order and classify the vibration modes of
multi symmetric structures The primary new innovation of this
report is the demonstration that it is not necessary to formulate a
structural dynamic model for more than a small pie shaped segment
of the structure This innovation required the development of
appropriate boundary conditions on the edges of the pie shaped
segment, and these have been derived for an equilateral triangle and a
hexagon Although these ideas are demonstrated herein for flat
polygonal membranes, they can be generalized to space frames, dish
antennas, and large three dimensional structures (Author)

A75-32830 # Corrosion control in naval aircraft A M
Malloy *Naval Aviation News*, vol 57, May 1975, p 32 39
Various aspects of the current naval aircraft corrosion problem

and attempts to solve it are discussed One of the main difficulties
derives from the incompatibility of strength and corrosion resistance
properties But a new aluminum alloy, AA7050, combines resistance
to exfoliation and stress corrosion with high strength, superior
toughness and excellent fatigue behavior Another area of concern is
coating composition, the history of coating materials development is
reviewed, with polyurethane playing an important role after WWII
S J M

A75-32839 Materials for gas turbines R J E Glenny
(Royal Aircraft Establishment, Farnborough, Hants , England), J E
Northwood (National Gas Turbine Establishment, Farnborough,
Hants , England), and A Burwood-Smith (Ministry of Defence,
London, England) *International Metallurgical Reviews*, vol 20, Mar
1975, p 1 28 257 refs

The major components of gas turbines and their materials
requirements are outlined The properties, advantages, and limita-
tions of materials which have been and are being used in gas turbines
are then described in the following groups aluminium alloys,
magnesium alloys, titanium and its alloys, steels, and finally nickel-
and cobalt base alloys The applications of the last group of alloys
and the importance of their metallurgical stability in turbine blades,
discs, nozzle guide vanes, and sheet metal components are discussed
Corrosion and its prevention are then considered, followed by
sections on experimental materials including alloys of chromium and
the refractory metals, ceramics, and fibre composites Future trends
and prospects are discussed briefly in a concluding section (Author)

A75-32840 Chemical milling J W Dini (Sandia Labora-
tories, Livermore, Calif) *International Metallurgical Reviews*, vol
20, Mar 1975, p 29 55 191 refs

Chemical milling has been used to advantage in removing excess
material and reducing the overall weight of metal parts It is a
valuable complementary technique to conventional milling and
machining methods and is particularly useful for removing metal
from thin sections or from parts that are already shaped The first
section of this report discusses chemical milling generally, describing
the process, its applications, advantages and limitations, chemical
milling solutions, maskants, and various other aspects of the chemical
milling process The second section considers the effectiveness of
chemical milling for some specific materials aluminium, beryllium,
magnesium, titanium, steel, and some stainless steel alloys Various
chemical milling solution formulations are presented and effects on
such factors as mechanical and fatigue properties are considered
(Author)

A75-32907 # Aerodynamic heating in gaps in the presence
of protuberances and shock wave impingement F T Hung and C A
Scottoline (Rockwell International Corp , Downey, Calif) *American
Institute of Aeronautics and Astronautics, Thermophysics Con
ference, 10th, Denver, Colo , May 27-29, 1975, Paper 75 670* 8 p
15 refs

An experimental investigation of gap aerodynamic heating with
external pressure gradient was conducted at Mach 5 2 Pressure
gradients were created on a sharp leading edge flat plate by either
cylindrical protuberances or impinging shock waves generated by
two dimensional wedges Effect of pressure gradient level on gap
heating was determined by varying wedge angle, cylinder diameter
and cylinder orientation Gaps with different orientations and widths
were tested and both laminar and turbulent external flows were
studied Results indicate that heating in gaps with external pressure
gradients can be orders of magnitude higher than the zero pressure
gradient case Correlations were derived based on test results
(Author)

A75-32954 # **Study of a strongly asymmetric turbulent wake behind a profile with upper surface separation** (Etude du sillage turbulent fortement asymetrique derriere un profil avec decollement d'extrados) P E Lemonnier and L F Tsen (Poitiers, Universite, Poitiers, France) Jugoslovensko Drustvo za Mehaniku, Yugoslav Congress of Rational and Applied Mechanics, 12th, Ohrid, Yugoslavia, June 3-8, 1974, Paper 10 p 5 refs In French Direction des Recherches et Moyens d'Essais Contract No 71/349/2

Wind-tunnel experiments were performed to study the incompressible turbulent wake produced by a plane profile at a nonzero angle of incidence with upper surface separation A Prandtl-Kolmogoroff type turbulence model was derived which, when used in the Reynolds equations and the equations for the turbulent kinetic energy, permits satisfactory theoretical wake prediction The turbulence models determined experimentally for a wake produced by a profile with zero incidence were confirmed by measurements made on the wakes produced by a profile with nonzero incidence and upper surface separation   A T S

A75-32995 # **Formation of flexibility matrices of a structure based on known yields at arbitrary points** (Formiranje matrica gipkosti strukture na bazi poznatih ugiba u proizvoljnim tackama iste) S Lukic (Vazduhoplovnotehnicki Institut, Zarkovo, Yugoslavia) Jugoslovensko Drustvo za Mehaniku, Yugoslav Congress of Rational and Applied Mechanics, 12th, Ohrid, Yugoslavia, June 3-8, 1974, Paper 10 p 6 refs In Serbo-Croatian

A method is developed for forming the flexibility matrix of a structure based on the known yeilds at arbitrary points As an example, an experimental procedure for determining the flexibility matrix of an aircraft wing is explained   A T S

A75-33103 # **Observing cold-night temperatures of agricultural landscapes with an airplane-mounted radiation thermometer** P R Nixon (Agricultural Research Service, Weslaco, Tex) and T A Hales (Texas A & M University, Weslaco, Tex) Journal of Applied Meteorology, vol 14, June 1975, p 498 505 15 refs

A75-33150 # **Fabrication of one-piece-forged thin walled parts having variable cross section** (Izgotovlenie tsel'noshtampovannykh tonkostennykh detalei peremennogo sechenia) O V Popov Moscow, Izdatel'stvo Mashinostroenie, 1974 120 p 20 refs In Russian

The present work explains the theoretical and technological principles of producing one-piece-forged thin-walled parts of variable cross section The range of application of such parts in the construction of aircraft and other machines and mechanisms is considered An explanation is given of the technological processes used in forming such parts by bulk forging from thin-walled blanks using thermal and stress intensification   A T S

A75-33187 **Recent advances in in-flight simulator technology** G W Hall (Calspan Corp , Buffalo, N Y) In Annual Simulation Symposium, 8th, Tampa, Fla , March 12 14, 1975, Proceedings Symposium sponsored by the Society for Computer Simulation Tampa, Fla , Annual Simulation Symposium, 1975, p 11 29 7 refs

The mechanization, uses, recent technological developments, and future prospects of in flight simulators are reviewed The response feedback and model following systems used in airplane in-flight simulators are described The principles of operation and the primary functions of several representative in flight simulators used in conventional and V/STOL simulation are discussed Among the in flight simulators under development are sophisticated variable-stability helicopter with six-degree of freedom control, a Space

Shuttle training aircraft, and an airline training total in flight simulator   S D

A75-33331 # **Determination of surface roughness of materials** (Opredelenie sherokhovatosti poverkhnosti materialov) V F Kameko, E P Iaskevich, Iu T Reznichenko, V M Kovtunenko, V K Mostipan, V A Sakhnov, V S Babkin, and I S Garelik Aerodinamika Razrezhennykh Gazov, no 7, 1974, p 51-59 6 refs In Russian

The parameters of surface roughness of sheet-metal samples of magnesium aluminum alloys (AMg6-M, D16-A-T, MA2 1M) used as the outer surface of an aircraft are determined by profilogrammetric and stereophotogrammetric techniques The roughness parameters thus obtained are represented analytically as the terms of a Fourier series The dominant harmonics of the roughness profile are determined from the amplitude phase characteristics obtained for each material under study The results indicate that the surface of the analyzed materials can be considered as being of low roughness   S D

A75-33339 # **Free-molecular interference of cylinders with oblique ray reflection** (Svobodnomolekuliarnaia interferentsiia tsilindrov pri luchevom otrazhenii s naklonom) V L Sergeev Aerodinamika Razrezhennykh Gazov, no 7, 1974, p 137-147 In Russian

A solution is obtained to the problem of interaction between infinite parallel cylinders situated in a free-molecular hypersonic (M = infinity) gas flow in the case of oblique ray reflection of atoms from the surface The ray model of atom reflection from a surface takes into account the relationship between average reflection velocity and angle of incidence The local fluxes of mass, momentum, and energy are calculated along with the air drag coefficients for different angles of attack and for various distances between the cylinders The air drag coefficients for rays reflected normal to the surface are compared to those for rays reflected at an oblique angle   S D

A75-33346 # **Experimental investigation of friction on a plate in the flow of a rarefied gas** (Eksperimental'noe issledovanie trenia na plastine v potoke razrezhennogo gaza) N M Bazarnova, A A Krylov, and B B Starikov Aerodinamika Razrezhennykh Gazov, no 7, 1974, p 211-219 6 refs In Russian

A75-33417 **Sound radiation from a bounded thin inhomogeneous plate reinforced with N ribs and driven by boundary-layer pressure fluctuations** R A Mikhitarov (Akademiia Nauk SSSR, Akusticheskii Institut, Moscow, USSR) (Akusticheskii Zhurnal, vol 20, Nov -Dec 1974, p 863-873) Soviet Physics - Acoustics, vol 20, May-June 1975, p 528-533 6 refs Translation

A75-33427 # **A theoretical analysis for three dimensional ram wings in parallel walls** H Nakatani, Y Miyai (Osaka Prefecture, University, Osaka, Japan), and K Minami (Kawasaki Heavy Industrial Co , Ltd , Kobe, Japan) Japan Society for Aeronautical and Space Sciences, Transactions, vol 18, Mar 1975, p 12 28 5 refs

The method of matched asymptotic expansions is applied to the analysis of a three-dimensional ram wing in parallel walls In this case the flows above and below the wing and trailing vortex wake, are two-dimensional in x, y plane The edge flow solutions are applied along the side edges of the wing and wake as well as along the leading and trailing edges By matching, the solution which is uniformly valid is obtained in the overall flow regions As numerical applications, simple analytic results for semi-elliptic and semi-circular flat wings are obtained Total lift and induced drag coefficients of those wings having straight trailing edges are calculated for different ratios of the distance of parallel walls to the height of trailing edge of the wing

(Author)

A75-33435 # **Side forces on unyawed slender inclined aerodynamic bodies** H C Kao (Northrop Corp, Hawthorne, Calif) *Journal of Aircraft,* vol 12, Mar 1975, p 142 150 15 refs

Wind tunnel tests in recent years have indicated the existence of nonzero side forces and yawing moments on a fuselage model, configuration build-up, and a complete airplane model at high angles of attack but zero angle of sideslip These forces and moments are a potential hazard to aircraft stability and control Based on observations in some related experiments, theoretical consideration and finally some interpretation, a simple model is proposed to describe the flow characteristics of these nonzero forces and moments A prediction method resulting from this model with correlation parameters taken directly from the published papers is formulated The calculated results are compared with low-speed test data of a 10% scale F 5E fuselage model and a circular tangent ogive with afterbody and show satisfactory agreement (Author)

A75-33436 # **Image system solution for store aerodynamics with interference I** F W Martin (Auburn University, Auburn, Ala), G H Saunders (ARO, Inc, Arnold Air Force Station, Tenn), and C J Smith (Electronic Data Systems, New York, N Y) *Journal of Aircraft,* vol 12, Mar 1975, p 151 155 7 refs

The aerodynamic interference problem for external aircraft stores has been analyzed using the image system technique In order to facilitate this analysis it has been assumed that small perturbation solutions are valid It is further assumed that the external stores are slender, axisymmetric bodies and that the interference can be analyzed by first assuming a cross flow solution Both body body and wing-body interference solutions have been obtained For the body-body solution, the image systems in the cross flow plane consist of source sink pairs appropriately located by using the Milne Thomson circle theorem The actual three-dimensional source-sink pairs are displaced from the body axis according to the cross flow image system The strengths of the source sink pairs are then determined by the Rankine method Good agreement has been found between the theoretical and experimental results It is felt that this approach to the interference problem is a significant advancement in that this technique requires only successive superposition whereas most other methods such as vortex lattice, source panels, etc, require, in general, simultaneous solutions (Author)

A75-33437 # **Image system solution for store aerodynamics with interference II** F W Martin (Auburn University, Auburn, Ala) and K B Walkley (LTV Aerospace Hampton Technical Center, Hampton, Va) *(Aircraft/Stores Compatibility Symposium, Sacramento, Calif, Sept 18-20, 1973)* Journal of Aircraft, vol 12, Mar 1975, p 156-161

To predict accurately the trajectory of a store from an aircraft in an interference flowfield, the mutual aerodynamic interference problem for external aircraft stores is analyzed using the vortex image system technique It is assumed that small perturbation solutions are valid, that the external stores are axisymmetric slender bodies, and that mutual interference can be analyzed by a preliminary cross flow solution For the wing-pylon-body solution, the necessary image system is found by applying the Milne-Thomson circle theorem to a pair of counter-rotating planar vortices in the vicinity of a circle The strengths of the vortex image system are then obtained by satisfying the body boundary conditions at designated control points on the external stores It is found that the experimental results are consistent with theory S D

A75-33438 # **Regenerative turbofans - A comparison with nonregenerative units** J A C Kentfield (Calgary, University, Calgary, Alberta, Canada) *Journal of Aircraft,* vol 12, Mar 1975, p 174-181 9 refs

A theoretical study was made of the performance of regenerative turbofans It was concluded that, on a thermodynamic and aerodynamic basis, compared with conventional nonregenerative, high-pressure-ratio, high-bypass-ratio units, regenerative turbofans can have specific fuel consumptions about 17% lower for flight, and up to 24% lower for sea-level static, operation It was assumed that the effective nacelle drag coefficients of regenerative turbofans would not be higher than those of nonregenerative engines provided greater installation complexity is acceptable The predicted thrust-to-weight ratio of regenerative units is approximately 3 2 1 compared with 6 1 for high pressure, high-bypass-ratio machines Typically, assuming that both engine types are suitable alternatives for a particular aircraft, this weight penalty would be counteracted by a fuel saving after about 4 hr flying without reserves The corresponding figure for small aircraft, for which high-pressure-ratio turbofans appear to be impractical, is about 2 hr In the absence of major developments in regenerator technology regenerative turbofans appear to be restricted to relatively low-thrust applications (Author)

A75-33447 **Variable geometry today** R M Braybrook *Air International,* vol 8, Mar 1975, p 111 124

Contemporary applications and requirements of variable geometry (VG) in high speed aviation are discussed Advantages and problems associated with the use of the VG wing are assessed, and the development of NASA's outboard hinge is described The performance of the F 111 is evaluated, and the latest swing wing aircraft are discussed in detail, including the American EF 111A, F 14A, and B1, the Soviet Su 20 and MiG 23, the French Mirage G, and the European Panavia MRCA Reference is made to the MiG Fencer and Tupolev Backfire, two Soviet strategic fighter bombers about which very little information is available F G M

A75-33448 **Mitsubishi's mentor** **Supersonics from Nagoya** E Sekigawa *Air International,* vol 8, Apr 1975, p 170 176

Development and specifications of the supersonic Mitsubishi T-2 advanced trainer are described Of conventional semi-monocoque design, the T-2 has a shoulder mounted wing with a thickness/chord ratio of 4 8% and leading edge sweep angles ranging from 68 deg at the root through 42 deg out to the dog tooth extension to 36 deg at the tip Built on a multi spar torsion box, each wing has two leading edge flaps and a large, single-slotted trailing edge flap The aircraft is powered by two turbofans each rated at 4,620 lb dry and 7,070 lb with full reheat Its maximum speed is 1,056 mph at 36,000 ft with an initial climb rate of 35,000 ft/min The combat training version is armed with one 20-mm multi-barrel rotary cannon plus two wingtip mounted Sidewinder or Mitsubishi air-to air missiles and four underwing rocket bombs P T H

A75-33449 **The annals of the polymorph - A short history of variable geometry II** *Air International,* vol 8, Apr 1975, p 185-190

The development of variable-geometry aircraft is traced from WW II German designs based on a variable skewed wing, through development of the variable sweep concept and the 'Swallow' concept of Wallis, to the Bell aircraft The Messerschmitt P 1101, originally designed as a single seat, single-jet fighter with a mid-wing swept 45 deg on the leading edges, served as the basis for the first successful variable sweep aircraft, the Bell X-5, in 1951 The basic characteristics of the X 5 are described, and the main results of several years of testing it are discussed P T H

A75-33450 **The annals of the polymorph - A short history of variable geometry III** *Air International,* vol 8, May 1975, p 249-257

Early aerodynamic problems associated with the variable-sweep wing were related to effects of changes in wing geometry on the aerodynamic center Design innovations related to NASA's outboard pivot provided the breakthrough which was destined to put the U S temporarily well ahead in variable geometry research American, European, and Soviet developments concerning variable-sweep aircraft are discussed Today, six military aircraft utilizing variable-sweep wings are in service Two others are flying in prototype form G R

A75-33483 # Influence of mistuning on rotor-blade vibrations L E El-Bayoumy (Consultants and Designers, Inc, East Hartford, Conn) and A V Srinivasan (United Aircraft Corp, Pratt and Whitney Aircraft Div, East Hartford, Conn) *AIAA Journal*, vol 13, Apr 1975, p 460-464 6 refs

This analysis is aimed at determining the influence of blade mistuning on the vibratory stress levels of turbine and compressor blades A frequency response analysis for a given rotor configuration shows that a large number of resonances may occur over a frequency band, the width of which is nearly 20% of the mean blade frequency The resonant amplitudes are a function of blade frequency and location on the rotor, and the amount of damping present in the system A parametric study is carried out to evaluate the response levels due to engine order excitation, aerodynamic and mechanical damping, and blade frequency deviation The resulting mode shapes and frequencies are in good agreement with the experimental findings reported earlier in the literature (Author)

A75-33485 * # Theoretical study of lift-generated vortex wakes designed to avoid rollup V J Rossow (NASA, Ames Research Center, Moffett Field, Calif) *AIAA Journal*, vol 13, Apr 1975, p 476-484 24 refs

Two hypothetical vortex wakes are introduced and studied theoretically to explore whether the rollup of lift-generated vortex sheets can be suppressed The circulation distribution across each wake is specified such that one rotates and the other translates as a unit due to their self-induced velocities Several span loadings are constructed from these solutions and the resulting inviscid wake structure is computed for several span lengths behind the generating wing by use of the discrete vortex method wherein the vortex wake is represented by an array of vortices The final distribution of vortices is then used to estimate the rolling moment on an encountering wing It is found that, even though the initial specified motions are not sustained, substantial reductions in rolling moment are predicted for certain ranges of the ratio of the span of the generating wing to the following wing (Author)

A75-33488 # Aeroelastic panel optimization with aerodynamic damping B L Pierson (Iowa State University of Science and Technology, Ames, Iowa) *AIAA Journal*, vol 13, Apr 1975, p 515-517 12 refs Research supported by the Iowa State University of Science and Technology

A number of numerical solutions are presented for the case in which aerodynamic damping is included in the problem formulation The solutions were obtained with the aid of the gradient projection method reported by Pierson (1974) Optical thickness ratio distributions for the simply supported solid panel and nondimensional real deflection distributions for the optimal simply supported solid panel are shown in graphs It is found that the shape of the optimal thickness distribution with damping remains relatively unchanged from that obtained without damping G R

A75-33550 B-1 airborne strategic deterrent *Air International*, vol 8, Feb 1975, p 59 64, 100

The B 1A now under development is a swing wing, supersonic strategic bomber with an unrefueled range of 6100 miles The bomber's primary mission tactic is to be low altitude penetration at near-sonic speed It would also be capable of high altitude supersonic missions A detailed cutaway drawing is given The B-1A concept, program tradeoffs, and development testing are discussed A T S

A75-33565 Problems of federal and state court jurisdiction and venue in products liability litigation Defendants viewpoint. M L Noyer *Journal of Air Law and Commerce*, vol 40, Autumn 1974, p 637-652 55 refs

Trends in choosing alternative forums for litigation are examined in the context of the defense in aviational products liability

suits The effects of long-arm statutes on jurisdictional choices is discussed, and precedents set in regard to jurisdiction in tortious acts are described Alternative ways for defense counsel to maneuver litigation to a more favorable forum are summarized, including invoking the doctrine of forum non conveniens, removing the action from state to federal court, and dismissal for improper venue Important cases involving airlines or aircraft manufacturers are discussed which have involved transfer of jurisdiction F G M

A75-33568 Air transportation of radioactive materials D K Eyberg *Journal of Air Law and Commerce*, vol 40, Autumn 1974, p 681-703 124 refs

Regulation of the air transport of radioactive materials is discussed, and proposals are made to improve such regulation An incident of radiation leakage from a package aboard a commercial airliner is reviewed, the effects of radiation on humans are described, and the functions of existing regulatory agencies are summarized Federal aviation regulations are outlined which pertain to the air transport of radioactive substances, and the inadequacies of such regulations are discussed, including lack of sufficient data on movements of hazardous materials, inadequate inspection efforts, and sporadic and ineffective enforcement actions It is proposed that regulatory and enforcement functions be centralized, consumer representatives be included on regulatory bodies, on-the-spot monitoring of radioactive shipments be implemented at all times, and only radioisotopes needed for medical purposes be transported on passenger-carrying planes F G M

A75-33569 Consequential and special damages - Tempest in the tariff W R Johnston *Journal of Air Law and Commerce*, vol 40, Autumn 1974, p 704-722 95 refs

Historical and legal background information is presented in regard to the CAB's Liability and Claim Rules and Practices Investigation (1970) and the subsequent decision by an administrative law judge that air carriers would be liable for consequential and special damages incurred in the course of handling air freight The common-law rule of carrier liability is traced from its origins under English common law (1703) through the Federal Aviation Act of 1958, and the development of liability for consequential and special damages is similarly traced from the British landmark case of Hadley v Baxendala (1854) through the major American cases up to 1970 The arguments presented in the CAB's (1970) investigation are presented, and it is concluded that liability for consequential and special damages is almost certain to be imposed at some future time F G M

A75-33613 S-3A stall testing and auto-throttle development/testing P S Norton (Lockheed California Co, Burbank, Calif) *Society of Experimental Test Pilots, Technical Review*, vol 12, no 3, 1975, p 5-12

The thick wing section of the S-3A results in a stall that occurs at the wing leading edge and in an abrupt decrease of the lift coefficient at the stall The development of the landing configuration stall characteristics described was intended to optimize the stall-warning buffet, roll-off at the stall, and the magnitudes of the stall speeds themselves In addition, the landing configuration lift characteristics are given, and the development of the auto-throttle is discussed V P

A75-33614 The S-3A carrier suitability demonstration D R Wilson (LTV Corp, Vought Systems Div, Dallas, Tex) *Society of Experimental Test Pilots, Technical Review*, vol 12, no 3, 1975, p 13-21

A test program which demonstrated the suitability of the S-3A for use on aircraft carriers is described The program involved 53 landing and 14 catapulting demonstration, including the arrested landing phase at minimum weight, off-center arrestment, rolled and yawed arrestments, rolled arrestment, tail-down, nose-down, and mean attitude high-sink, free-flight arrestment, and deck obstruction impact-sensitivity to error tests V P

A75-33615 YF-16 - A rare opportunity P F Oestricher (General Dynamics Corp , Convair Aerospace Div , San Diego, Calif) *Society of Experimental Test Pilots, Technical Review,* vol 12, no 3, 1975, p 22-26

A pilots report is presented on the testing of the YF-16 fighter aircraft and on the characteristics of the craft itself The principal systems of the fighter are discussed **V P**

A75-33617 Bell Helicopter/NASA/Army XV-15 status report G L Colvin (Bell Helicopter Co , Fort Worth, Tex) *Society of Experimental Test Pilots, Technical Review,* vol 12, no 3, 1975, p 33-36

The XV-15 tilt rotor aircraft, designated model 301 by the Bell Helicopter Company, is being designed as a flight research vehicle to study the use of tilt rotor technology in civil and military missions The program status of the helicopter is updated and reviewed **V P**

A75-33618 Stone Spin Shorthand, including Spin Data Card and sample Criteria Spin Set R R Stone (Beech Aircraft Corp , Wichita, Kan) *Society of Experimental Test Pilots, Technical Review,* vol 12, no 3, 1975, p 37-42

Experimental flight testing of out-of-control flight requires extra emphasis on the standard test objectives of accuracy, consistency, and thoroughness to ensure safety during the test effort The test program must be designed to assure safety of the operational user by exploring the entire out-of-control potential The three flight test innovations proposed for the 1000 + Spin YT-34C Test program are a Spin Shorthand for glance reference to cockpit control positions for entry, spin to steady state, and recovery, a Spin Data Card adapted to the Spin Shorthand, and a sample Criteria Spin Set to provide a comprehensive matrix of spins and recoveries for thorough definition of spin characteristics **V P**

A75-33619 Why so few all new General Aviation aircraft J R Humphreys *Society of Experimental Test Pilots, Technical Review,* vol 12, no 3, 1975, p 43-50

The question is raised why the General Aviation portion of the aircraft industry (all aircraft other than military and airlines types) does not offer 'all new' models more often, in spite of the assurance of marketing departments that some of the new aircraft designs already engineered are just what people are waiting for The low-risk policies of boards of directors and top management, and the economic, financial, and other factors which influence decision making are outlined **V P**

A75-33620 HUD - An important new aid to the L S O R L Brace (U S Navy, Washington, D C) *Society of Experimental Test Pilots, Technical Review,* vol 12, no 3, 1975, p 51-55

The tasks and responsibilities of the LSO (Landing Signal Officer) are outlined, along with his demanding job requirements Attention is centered on one of the requirements which is paradoxial in the sense that the LSO simply could not maintain visual contact with an approaching aircraft and at the same time examine a mass of panel mounted indicators An innovative solution to this paradox - the Heads Up Display (HUD) is described **V P**

A75-33621 Rotor Systems Research Aircraft /RSRA/ C M Reine (United Aircraft Corp , Sikorsky Aircraft Div , Stratford, Conn) *Society of Experimental Test Pilots, Technical Review,* vol 12, no 3, 1975, p 56-61

The RSRA was conceived by NASA and the U S Army as a versatile research aircraft for flight testing a wide variety of advanced helicopter and compound rotor systems, such as variable-geometry, variable-twist, and variable-diameter rotors The aircraft design, handling qualities, flight control systems, stability augmentation system, and force feel system are discussed **V P**

A75-33762 # Boron/aluminum for advanced technology aircraft A R Robertson (General Dynamics Corp , Convair Div , San Diego, Calif) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo , May 27-29, 1975, AIAA Paper 75-790* 7 p 6 refs Contract No F33615-74-C-5151

A program is being performed to demonstrate that a boron/aluminum component design can replace an all-metal design and have not only performance advantages but cost advantages as well Five components from the B-1 were studied in sufficient detail to determine the configuration, weights, and projected manufacturing costs of designs using boron/aluminum Composite configurations were provided that could be substituted directly for the baseline design with only very minor modifications to the surrounding structure Weight savings predicted for the composite designs varied between 8 and 56% With four of the parts examined, the predicted cost savings varied between 24 and 69% The fifth part was not cost effective A diffusion-bonded titanium rib from the root of the wing was selected for detailed evaluation, the results of which are presented Detailed manufacturing costs were prepared for the baseline titanium configuration and the boron/aluminum configuration High-cost manufacturing areas were identified and were the basis for a manufacturing development program **(Author)**

A75-33763 # Analytical prediction of fatigue crack growth at cold-worked fastener holes J B Chang (Rockwell International Corp , Los Angeles, Calif) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 16th, Denver, Colo , May 27-29, 1975, AIAA Paper 75-805* 7 p 23 refs Research sponsored by the Rockwell International Independent Research and Development Program

A methodology for the quantitative prediction of crack growth behavior at cold-worked fastener holes under fatigue cyclic loading has been developed The proposed analytical prediction technique is based on an effective stress field concept which accounts for the amount of the compressive residual stress existing at the edge of the cold worked hole Stress intensity factor ranges (delta K) and crack growth rates (da/dn) are all formulated in terms of the effective stress field An existing fatigue crack growth analysis computer program has been modified to account for these changes This program was subsequently used to study the B 1 fracture mechanics design development test data Good correlations have been obtained **(Author)**

A75-33832 The multi-mission Mirage F *Air International,* vol 8, June 1975, p 285-291

The Mirage F swept wing fighter aircraft was designed as a successor to the delta wing Mirage III The F1C has a landing approach speed of 160 mph, compared to the Mirage III's 210 mph The F1 has an advanced navigation and attack system, including a microminiaturized Cyrano IV radar which has a 40% better range than the latest Mirage III radar The F1C is powered by an Atar 9K50 straight turbojet, its maximum speed is Mach 2 2 at high altitude and its service ceiling is 65,600 ft The F1E is powered by an M53 single-spool turbojet, which improves several performance parameters significantly The armament of the F1C and F1E consists of cannons and air to air missiles A detailed cutaway drawing of the Mirage F1C is given **A T S**

A75-33931 * # Computation of nonequilibrium three-dimensional inviscid flow over blunt-nosed bodies flying at supersonic speeds J V Rakich, H E Bailey, and C Park (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn , June 16-18, 1975, Paper 75-835* 14 p 22 refs

A computer code based on the method of characteristics is

described and applied to the study of two- and three-dimensional chemical nonequilibrium flow over sharp and blunt nosed bodies Nonequilibrium flow over a wedge is used to show the approach to equilibrium flow, and to demonstrate the nature of the reaction zone behind the bow shock wave The structure and development of a blunt-body entropy layer in nonequilibrium flow is examined for a blunt cone at zero incidence Three dimensional computations for the space shuttle body at 30 deg angle of attack are presented A nondimensional scaling parameter, the Damkohler number, which is the ratio of flow time to chemical reaction time, is calculated and its significance discussed   (Author)

A75-33933 #   Aerodynamic characteristics of an axisym metric body undergoing a uniform pitching motion L H Smith and R H Nunn (U S Naval Postgraduate School, Monterey, Calif) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn, June 16-18, 1975, Paper 75-838* 10 p 15 refs

An experimental investigation was conducted to determine the effect of a uniform pitching motion on a slender axisymmetric body while undergoing large excursions in angle of attack Force and moment measurements were obtained for a slender tangent-ogive/cylindrical body over a range of Reynolds numbers from 50,000 to 140,000 while varying the angle of attack from zero to 90 degrees and the pitch rate between zero and 281 degrees per second Smoke flow visualization studies were used as an aid in assessing wake vortex transitions The results of the investigation show that there is an increment of normal force directly attributable to the uniform pitching motion The incremental increase in the normal force is sufficient to cause significant errors in calculating body damping derivatives from static force measurements Distinct wake vortex transitions at approximately 20, 50 and 65 degrees were observed The effect of a uniform pitching motion shifts the angle of attack at which these wake vortex transitions occur, and can reduce the abruptness of those transitions   (Author)

A75-33936 #   A modern look at conformal mapping, includ-ing doubly connected regions D C Ives (Grumman Aerospace Corp, Bethpage, N Y) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn, June 16-18, 1975, Paper 75 842* 9 p 17 refs

With the advent of large scale digital computers, numerical solution of the transonic flow equations in two dimensions has proven feasible In such calculations it is convenient, and often crucial, to conformally map the region of interest onto a simple domain so that a simple finite difference system can be employed This paper updates a well known airfoil conformal mapping method (Theodorsen and Garrick) with modern techniques, greatly enhanc ing the mapping speed and accuracy while simplifying the analysis Also, a powerful new class of conformal transformations is in troduced, and applied to a two element airfoil   (Author)

A75-33938 * #   The dynamics of atmospheric dust particles in aircraft auxiliary power radial inflow turbines W B Clevenger, Jr and W Tabakoff (Cincinnati, University, Cincinnati, Ohio) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn, June 16-18, 1975, Paper 75-844* 12 p 9 refs NASA supported research

The results of analytical and experimental studies of the trajectories that atmospheric dust particles follow as they move through a radial inflow turbine are presented The study reveals the nature of the impacts that occur within the turbine and indicates which surfaces are expected to experience the most severe erosion In addition, a dimensionless parameter is derived which can be used during preliminary design analysis to indicate the sizes of the particles that will be most damaging to the turbine   (Author)

A75-33950 * #   A rigorous solution of the Navier-Stokes equa-tions for unsteady viscous flow at high Reynolds numbers around oscillating airfoils T Bratanow, H Aksu, and T Spehert (Wisconsin, University, Milwaukee, Wis) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn, June 16-18, 1975, Paper 75-863* 12 p 11 refs Grant No NGR 50-007-001

A method based on the Navier-Stokes equations was developed for analyzing the unsteady incompressible viscous flow around oscillating airfoils at high Reynolds numbers The Navier-Stokes equations have been integrated in their classical Helmholtz vorticity transport equation form, and the instantaneous velocity field at each time step was determined by the solution of Poisson's equation A refined finite element was utilized to allow for a conformable solution of the stream function and its first space derivatives at the element interfaces A corresponding set of accurate boundary conditions was applied, thus obtaining a rigorous solution for the velocity field The details of the computational procedure and examples of computed results describing the unsteady flow charac-teristics around the airfoil are presented   (Author)

A75-33951 #   A calculation method for unsteady subsonic flow about harmonically oscillating wing-body configurations R Roos, B Bennekers, and R J Zwaan (National Luchtvaart laboratorium, Amsterdam, Netherlands) *American Institute of Aero-nautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn, June 16 18, 1975, Paper 75-864* 11 p 13 refs Research supported by the Royal Netherlands Air Force

A description is given of a panel method for the calculation of the aerodynamic loading on harmonically oscillating wing-body configurations in subsonic flow Neglecting their thickness, the loading on the lifting surfaces is assumed to be generated by a distribution of unsteady lifting lines The loads on the body are represented by an unsteady source panel distribution A way is indicated to introduce the effect of the steady flow field into the unsteady calculations The method provides local and total coef-ficients as well as detailed pressure distributions on both the lifting surfaces and the bodies The applicability of the method is shown in a comparison of calculated and experimental pressure and load distributions on a wing-tip tank-pylon store configuration   (Author)

A75-33952 #   Local momentum theory and its application to the rotary wing A Azuma and K Kawachi (Tokyo, University, Tokyo, Japan) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn, June 16-18, 1975, Paper 75-865* 12 p 39 refs

A new momentum theory, named local momentum theory, has been developed and applied to study the rotor aerodynamics The theory is based on the instantaneous momentum balance with the blade elemental lift at a local station of the rotor rotational plane A rotor blade is considered to be decomposed into a series of wings each of which has an elliptical circulation distribution and is so arranged that a tip of each wing is aligned to the blade tip By neglecting the upwash flow outside the said wings and by introducing an attenuation coefficient to represent timewise change of the local induced velocity after an impact of blade passage, the induced velocity distribution and the spanwise aerodynamic loading of the blade can easily be obtained It will be shown that applying the new theory to both steady and unsteady aerodynamic problems lead to fruitful results with much less computation time than the case of using the vortex theory in which complexity of calculation and difficulty of convergence are unavoidable   (Author)

A75-33953 * #   A three-dimensional solution of flows over wings with leading-edge vortex separation J A Weber, G W Brune, F T Johnson, P Lu, and P E Rubbert (Boeing Co, Seattle, Wash) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn, June 16-18, 1975, Paper 75-866* 9 p 13 refs Contract No NAS1-12185

The application of a new, general, potential flow computational

technique to the solution of the subsonic, three dimensional flow over wings with leading edge vortex separation is presented The present method is capable of predicting forces, moments, and detailed surface pressures on thin, sharp edged wings of rather arbitrary planform The wing geometry is arbitrary in the sense that leading and trailing edges may be curved or kinked and the wing may have arbitrary camber and twist The method employs an inviscid flow model in which the wing, the rolled up vortex sheets, and the wake are represented by piecewise continuous quadratic doublet sheet distributions The Kutta condition is imposed along all wing edges Strengths of the doublet distributions as well as shape and position of the free fortex sheet spirals are computed in iterative fashion starting with an assumed initial sheet geometry The method is verified by numerous computed results   (Author)

A75-33954 #   A model for the dynamics of a separation bubble used to analyze control-surface buzz and dynamic stall J D Lang (U S Air Force Academy, Colorado Springs, Colo) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn , June 16 18, 1975, Paper 75-867* 12 p 20 refs USAF-sponsored research

A theory is developed which models separation bubble dynamics It includes a quasi-steady model for the external shear layer, and unsteady mass flow within the bubble at a mean reversed-flow velocity Pressure perturbations are related to the unsteady mass flux in a quasi-steady momentum equation Lag in growth and modifications to the 'dead air' pressure of an unsteady bubble are predicted and verified experimentally The experiments, on an airfoil with oscillating spoiler and flap, included a control surface buzz analogy, where the flap and spoiler were mechanically coupled Limit-cycle behavior was observed and is predicted by a theory which includes the model for bubble growth   (Author)

A75-33955 * #   Maximum lift of upper surface blowing STOL aircraft with swept wings D G Koenig and K Aoyagi (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn , June 16-18, 1975, Paper 75-868* 8 p 9 refs

In a recent large scale wind tunnel investigation of a 4 engine upper surface blowing configuration in the Ames 40- by 80-Foot Wind Tunnel, the large nacelles extending well above the wing upper surface had a sizable adverse effect on maximum lift The presence of the nacelles produced high upwash angles between the nacelles and near the fuselage The severity and alleviation of this problem is discussed with the use of calculated spanwise loadings The combined effects of wing leading edge stall control, wing sweep, and nacelle cross section modification were considered in maximum lift improvement Experimental results of these effects are presented   (Author)

A75-33956 #   Effect of simulated forward flight on subsonic jet exhaust noise A B Packman and K W Ng (United Aircraft Corp , East Hartford, Conn) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn , June 16-18, 1975, Paper 75-869* 14 p 15 refs

A wind tunnel model program was conducted to investigate the effect of aircraft forward speed on the jet noise characteristics of a single subsonic jet Electrically heated air was supplied to a convergent nozzle located on the tunnel centerline The nozzle diameter of 2 4 in produced a tunnel to nozzle area ratio of 220 Microphones were located at a radius of 50 nozzle diameters in the anechoic chamber outside the tunnel flow Nozzle operating conditions covered a range of velocities up to 1669 fps, and temperatures to 900 F Wind tunnel speeds ranged from near zero to 350 fps Measured noise data were corrected for tunnel shear layer refraction and moving medium convection effects, thus simulating the effects on the jet noise sources of relative velocity during an aircraft flyover Measured overall sound pressure level reductions due to relative velocity were correlated with relative velocity raised to an exponent

that increased towards the aft angles The results showed general agreement with recent National Gas Turbine Establishment (NGTE) test results obtained in a large wind tunnel   (Author)

A75-33957 * #   Wind tunnel measurements of forward speed effects on jet noise from suppressor nozzles and comparison with flight test data A Atencio, Jr (U S Army, Air Mobility Research and Development Laboratory, NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn , June 16-18, 1975, Paper 75-870* 10 p 12 refs

The results of a test program conducted in the NASA Ames 40-by 80-Foot Wind Tunnel to determine the effect of forward speed on the noise levels emanating from a conical ejector nozzle, a 32-spoke suppressor nozzle, and a 104-elliptical-tube suppressor nozzle are reported It is shown that noise levels are reduced as forward speed is increased and that, for one suppressor configuration, forward speed enhances suppression Comparisons of noise measurements made in the wind tunnel with those obtained in flight tests show good agreement It is concluded that wind tunnels provide an effective means of measuring the effect of forward speed on aircraft noise   (Author)

A75-33960 #   Finite element analysis of unsteady transonic flow S T K Chan and M R Brashears (Lockheed Missiles and Space Co , Inc , Huntsville, Ala) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn , June 16-18, 1975, Paper 75 875* 10 p 9 refs Contract No F33615 73-C-3144

The finite element technique, in conjunction with the method of weighted residuals, is described herein for the analysis of transonic flow about an airfoil executing harmonic motion The analysis is based on equations obtained from small disturbance theory, but with the transonic effects properly accounted for Investigations are conducted along the lines of utilizing both the methods of Galerkin and least squares Preliminary findings to date are summarized, with some numerical results shown for the Galerkin formulation A computer code development based on the least squares method is in progress, with comparison between the two codes to be made in future studies   (Author)

A75-33961 #   Calculation of transonic flows using an extended integral equation method D Nixon *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn , June 16-18, 1975, Paper 75-876* 9 p 16 refs

An extended integral equation method for transonic flows is developed In the extended integral equation method velocities in the flow field are calculated in addition to values on the aerofoil surface, in contrast with the less accurate 'standard' integral equation method in which only surface velocities are calculated The results obtained for aerofoils in subcritical flow and in supercritical flow when shock waves are present compare satisfactorily with the results of recent finite difference methods   (Author)

A75-33962 * #   Transonic flow about a thick circular-arc airfoil J B McDevitt, L L Levy, Jr , and G S Deiwert (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn , June 16-18, 1975, Paper 75-878* 10 p 14 refs

An experimental and theoretical study of transonic flow over a thick airfoil, prompted by a need for adequately documented experiments that could provide rigorous verification of viscous flow simulation computer codes, is reported Special attention is given to the shock-induced separation phenomenon in the turbulent regime Measurements presented include surface pressures, streamline and flow separation patterns, and shadowgraphs For a limited range of free-stream Mach numbers the airfoil flow field is found to be

unsteady Dynamic pressure measurements and high-speed shadow-graph movies were taken to investigate this phenomenon Comparisons of experimentally determined and numerically simulated steady flows using a new viscous-turbulent code are also included The comparisons show the importance of including an accurate turbulence model When the shock boundary layer interaction is weak the turbulence model employed appears adequate, but when the interaction is strong, and extensive regions of separation are present, the model is inadequate and needs further development

(Author)

A75-33963 # An inverse method for the design of multiele-ment high-lift systems J C Narramore and T D Beatty (Douglas Aircraft Co, Long Beach, Calif) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn , June 16 18, 1975, Paper 75-879* 8 p 6 refs Research sponsored by the McDonnell Douglas Independent Research and Development Program

A multielement inverse potential flow program has been developed which will determine the section geometry required to produce a desired upper-surface pressure distribution on one or more airfoils of a two-dimensional multielement airfoil system An iterative procedure is used which modifies the camberlines of bodies on which the pressure is specified so that the calculated upper surface pressure distributions approach the desired pressure distributions Two options are available one which holds a constant thickness while changing the camberline and one which holds the lower surface shape constant while changing the camberline and thickness Both options require that the chord lengths and relative positions are held constant during the iterative procedure Examples of the results of the inverse process are presented which illustrate the accuracy of the program and its potential application to the design of improved high-lift systems (Author)

A75-33964 * # Supercritical airfoil flowfield measurements F X Hurley, F W Spaid, F W Roos (McDonnell Douglas Research Laboratories, St Louis, Mo), L S Stivers, Jr , and A Bandettini (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn , June 16 18, 1975, Paper 75-880* 10 p 16 refs

Detailed measurements in the transonic flowfield about a Whitcomb-type supercritical airfoil profile are presented including surface pressure distributions, far wake surveys, spark schlieren photographs, and a series of vector velocity profiles in the boundary layer and in the near wake A flowfield composite for the transonic drag rise condition is constructed from these data The boundary layer measurements are compared with current correlation and computation schemes, and the importance of viscous thickening effects is demonstrated by the results of wave drag rise calculations for the thickened and unthickened profiles (Author)

A75-33965 * # Inviscid to turbulent transition of trailing vortices J D Iversen (Iowa State University of Science and Technology, Ames, Iowa) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn , June 16-18, 1975, Paper 75 883* 8 p 12 refs NASA-supported research

The plateau region in which trailing vortices initially exhibit slow decay of maximum tangential speed is demonstrated with the aid of constant and variable eddy viscosity models The existence of the plateau is explained by the presence of the viscous core and by the necessity for transition of the initial, nearly inviscid profile to similarity far downstream Span loading is shown to affect the initial maximum tangential speed as well as the duration of the plateau region Triangular span loading is shown to present less hazard to trailing aircraft, at least in the near field, than elliptic loading because the inviscid profile for triangular loading exhibits a finite tangential speed at the vortex centerline and a large inviscid core (Author)

A75-33966 # Some wind tunnel measurement of the trailing vortex development behind a sweptback wing - Induced rolling moments on intercepting wings Z El-Ramly, W J Rainbird, and D G Earl (Carleton University, Ottawa, Canada) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn , June 16 18, 1975, Paper 75-884* 9 p 13 refs National Research Council of Canada Grant No A-7799

A75-33967 * # Experimental study of the effect of span loading on aircraft wakes. V R Corsiglia, V J Rossow, and D L Ciffone (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn , June 16-18, 1975, Paper 75-885* 11 p 17 refs

Measurements were made in the NASA Ames 40- by 80 Foot Wind Tunnel of the rolling moment induced on a following model in the wake 13 6 spans behind a subsonic transport model for a variety of trailing edge flap settings of the generator It was found that the rolling moment on the following model was reduced substantially, compared to the conventional landing configuration, by reshaping the span loading on the generating model to approximate a span loading, found in earlier studies, which resulted in reduced wake velocities This was accomplished by retracting the outboard trailing edge flaps It was concluded, based on flow visualization conducted in the wind tunnel as well as in a water tow facility, that this flap arrangement redistributes the vorticity shed by the wing along the span to form three vortex pairs that interact to disperse the wake

(Author)

A75-34112 * Propulsion system structural integration and engine integrity, Proceedings of the Symposium, U S Naval Postgraduate School, Monterey, Calif , September 3-6, 1974 Symposium sponsored by the U S Air Force, U S Navy, U S Army, and NASA Edited by W J Walker (USAF, Office of Scientific Research, Washington, D C) *Journal of Aircraft,* vol 12, Apr 1975 244 p

Current problems involving the structural integrity of propulsion systems, and proposed approaches to solving them, are reviewed Areas investigated include the stall hammershock at the engine inlet, distortion-induced vibration in fan and compressor blading, modeling engine static structures with conical-shell finite elements, design and development of low-cost, self-contained bearing lubrication systems for turbine engines, and roller bearing slip and skidding damage

S J M

A75-34113 # Structural integrity for propulsion systems J E Zollinger (USAF, Aeronautical Systems Div , Wright Patterson AFB, Ohio) *(U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif , Sept 3-6, 1974) Journal of Aircraft,* vol 12, Apr 1975, p 195 197

Current problem areas, analytical capability, and experimental techniques regarding the structural integrity of propulsion systems are summarized In addition, an outline for future research and development efforts is given Emphasis is on the recent increase in commercial and military problem events and the concomitant necessity for development and application of better structural tools, specifications, and tests S J M

A75-34114 # YF-16 air induction system design loads associated with engine surge P J Evans and P P Truax (General Dynamics Corp , Fort Worth, Tex) *(U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif , Sept 3-6, 1974) Journal of Aircraft,* vol 12, Apr 1975, p 205 209 7 refs

Basic data and procedures used to calculate structural loads due to engine surge on the YF-16 prototype fighter are presented The procedure is based on a correlation of transient pressure vs engine-compressor pressure ratio and relies heavily on extensive flight measured transient-pressure data from engine surge events on F-111

aircraft equipped with Pratt and Whitney TF30 family engines These data were supplemented and confirmed by theoretical calculations for the YF-16 and by test cell measurements of transient-pressure data from engine-surge events on the Pratt and Whitney F100-PW 100 engine, which is used in the YF 16 (Author)

A75-34115 # Review of hammershock pressures in aircraft inlets L C Young and W D Beaulieu (Rockwell International Corp, Los Angeles, Calif) *(U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif, Sept 3-6, 1974) Journal of Aircraft,* vol 12, Apr 1975, p 210 216 15 refs

Hammershock pressures caused by turbine engine stalls dictate the inlet duct structural design for high speed air vehicles The initial pulse strength is defined by the inlet airflow cutoff rate, engine bypass ratio, and cycle pressure ratio The inlet pressures are influenced by the inlet duct volume and area distribution and attenuation of the engine stall pulse by bypass or boundary layer control air bleed from the duct The scarcity of experimental data has inhibited in-depth hammershock analyses to date The B 1 Inlet/Engine Compatibility Test model had very extensive dynamic pressure instrumentation Deliberate engine stalls were made with off-design inlet geometry and/or by step engine fuel pulses Data are utilized to show hammershock pressure propagation through the inlet duct Test data will also be used to illustrate inlet design concepts for alleviation of transient pressure loads in the forward inlet region The B-1 inlet engine model test data enforce existing analytical and semiempirical hammershock prediction techniques
(Author)

A75-34116 # Control of gas turbine stator blade vibrations by means of enamel coatings D I G Jones (USAF, Materials Laboratory, Wright Patterson AFB, Ohio) and C M Cannon (Dayton, University, Dayton, Ohio) *(U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif, Sept 3-6, 1974) Journal of Aircraft,* vol 12, Apr 1975, p 226 230 AF Task 7351, AF Project 735106

This paper describes the application of a high temperature enamel coating to part of the surface area of the stator vanes of a jet engine, to increase the damping and thereby reduce aerodynamically induced resonant vibration failures The investigation showed that such a coating can increase the damping level by a very significant amount, particularly when it is initially very low as when the blades are stalled, for example The use of enamel coatings is a relatively new approach to resolving jet engine vibration problems, and many engineering problems have to be overcome before all high temperature vibrations are controllable Some of the engineering problems are discussed (Author)

A75-34118 # Propulsion system and airframe structural integration program M N Aarnes and J L White (Boeing Commercial Airplane Co, Seattle, Wash) *(U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif, Sept 3-6, 1974) Journal of Aircraft,* vol 12, Apr 1975, p 234 242 13 refs

The requirements for propulsion system and airframe structural integration are outlined The deficiencies in current practice are discussed and emphasis is placed on joint airframe and engine company participation in developing a comprehensive integration plan that will result in well defined system interfaces and a high level of risk awareness Structural analysis programs applicable to propulsion system and airframe integration analysis are discussed including input automation and substructuring capabilities Examples of propulsion system and airframe math models and typical substructures are presented including static structure and rotating components The importance of propulsion system loads is discussed Applications of general purpose structural analysis programs such as NASTRAN to propulsion system structure are given (Author)

A75-34119 # Rapid verification of engine rotor and case flexibilities by a modal comparison algorithm R A Marmol and J T Akin (United Aircraft Florida Research and Development Center, West Palm Beach, Fla) *(U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif, Sept 3-6, 1974) Journal of Aircraft,* vol 12, Apr 1975, p 242-246 5 refs

A computation technique has been developed in which localized dynamic flexibilities in an assembled rotor or case can be rapidly determined from experimental mode shape and frequency data A dynamic mathematical model of the structure is developed with empirical flexibility terms assigned to mechanical joints such as flanges, splines, couplings, etc The vibratory response of the structure is measured in laboratory tests and compared with calculated values Agreement between calculated and experimental mode shapes and frequencies is obtained by a computerized random search technique, which determines the flexibility terms that produce the best match between experimental data and calculated values for all of the vibration modes compared The technique was developed for rotor critical speed applications, but it may be applied to any simple or complex beam type structure (Author)

A75-34121 # Design and development of low-cost, self-contained bearing lubrication systems for turbine engines G W Hamburg, T D Moyer, R Smith, and R S Van Huysen (Teledyne, Inc, Teledyne CAE Div, Toledo, Ohio) *(U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif, Sept 3-6, 1974) Journal of Aircraft,* vol 12, Apr 1975, p 253 259

This paper discusses methods to simplify bearing lubrication systems for gas turbine engines The approaches presented are based on experience in the development of a small turbojet engine for a missile application During this development, the ability to operate under a very hostile environment was demonstrated, the environment included accelerating from standstill to full speed in the order of 12 sec after cold soaking in a -60 F environment, accelerating to full speed in less than half that time after hot soaking, running at temperatures experienced at speeds in excess of Mach 1, and operating at very high thrust loads The final thrust bearing configuration involved a self-contained pot lube system, but a grease-packed thrust bearing system was also successfully developed for a slightly less stringent set of operating conditions The development of the companion grease-packed roller bearing, which operates in the hot turbine end environment, is also discussed
(Author)

A75-34123 # Current seal designs and future requirements for turbine engine seals and bearings V P Povinelli, Jr (United Aircraft Corp, Pratt and Whitney Aircraft Div, East Hartford, Conn) *(U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif, Sept 3-6, 1974) Journal of Aircraft,* vol 12, Apr 1975, p 266 273 16 refs

Turbine engine mainshaft seals are a significant factor in overall engine performance Each engine application presents a different set of requirements often dictating solutions that employ one or more of the basic seal types ring seal, face seal, or labyrinth seal The aircraft turbine engines of the 1980's with corotational rotors will require seals that can operate at pressure differentials within the 345 N/sq cm (500 psi) to 413 N/sq cm (600 psi) range, gas temperatures within the 922 K (1200 F) to 1032 K (1400 F) range and surface velocities within the 152 m/sec (500 fps) to 183 m/sec (600 fps) range Currently developed seal systems demonstrate limited capability for meeting advanced requirements without imposing severe performance and system penalties Mainshaft bearings for these advanced engine applications will require operation in the 2 5 to 3 0 million DN level range Of the two basic bearing types employed, ball thrust and cylindrical roller, the latter presents the most challenge Additional bearing and mainshaft seal development is required to meet the requirements of tomorrow's aircraft engines (Author)

A75-34127 # High-speed rotor dynamics - An assessment of current technology for small turboshaft engines J M Vance (Florida, University, Gainesville, Fla) and A C Royal (U S Army, Air Mobility Research and Development Laboratory, Fort Eustis, Va) *(U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif , Sept 3-6, 1974) Journal of Aircraft,* vol 12, Apr 1975, p 295-305 61 refs

An extensive study was made to determine current needs for research in rotor dynamics to solve problems encountered in small high speed turboshaft engines for helicopter and aircraft propulsion The purpose of this paper is to report the state of-the-art for this area as completely and concisely as possible The present and past philosophy of rotor-bearing system design including the impact of the demand for front drives, is discussed Methods for critical speed prediction and high-speed balancing are reviewed The trend to higher speeds is seen to require consideration of new approaches to balancing through flexural modes The major parameters available for control by the designer are shown to be the bearing support properties, and recommendations are made for improving the accuracy of prediction of these properties (Author)

A75-34128 # Dynamic response of viscous damped multi-shaft jet engines D H Hibner (United Aircraft Corp , Pratt and Whitney Aircraft Div , East Hartford, Conn) *(U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif , Sept 3 6, 1974) Journal of Aircraft,* vol 12, Apr 1975, p 305 312 12 refs

Rotor synchronous vibration experienced on multi shaft aircraft engines results directly from rotor imbalance exciting the numerous critical speeds inherent in light weight, high-speed modern power plants The understanding and reduction of this dynamic response is essential during engine design and development phases This paper presents an efficient analytical technique capable of predicting the vibratory response of an engine with nonlinear viscous damping A unique transfer-matrix method is applied to the idealized equivalent engine system to produce an unusually small array of influence coefficients The damper equations for a closed-end viscous damper are derived from the basic Reynolds equation The analysis is applied to a two-shaft aircraft engine to illustrate the basic concepts of multi-shaft critical speeds and nonlinear viscous-damped response (Author)

A75 34130 # Philosophy, design, and evaluation of soft-mounted engine rotor systems N Magge (General Electric Co , Aircraft Engine Group, Lynn, Mass) *(U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif , Sept 3-6, 1974) Journal of Aircraft,* vol 12, Apr 1975, p 318 324 9 refs Grants No DAAJ01-72 C-0381, No DAAJ02-71-C-0050, No DAAJ02-68 C-0002

In the present paper, the design philosophy, criteria, and methods of evaluation for soft-mounted turbine-engine rotor systems used in aircraft engine design are described A major constituent of this method is a computer program for system vibration and static analysis (VAST) This program is capable of finding natural frequencies, normalized modes, and responses due to any distribution of exciting forces considering gyroscopic and shear-deflection effects Aircraft mounting and excitations from the helicopter rotor are also included in the computer analysis General Electric's T700 turboshaft engine serves to illustrate the squeeze film, soft-mounting concept of design Results from tests of the T700 engine, Advanced Technology Axial Centrifugal Compressor (ATACC), T64 turboshaft, TF34 turbofan, and other engines are summarized, verifying the advantages of soft-mounted rotor systems (Author)

A75-34131 # Advances in fan and compressor blade flutter analysis and predictions A A Mikolajczak, R A Arnoldi, L E Snyder, and H Stargardter (United Aircraft Corp , Pratt and Whitney

Aircraft Div , East Hartford, Conn) *(U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif , Sept 3 6, 1974) Journal of Aircraft,* vol 12, Apr 1975, p 325 332 14 refs Contract No N00019-72-C-0187

A unified approach to flutter prediction has been developed, in which aeromechanical stability of the blade-disk system is expressed in terms of a stability parameter which measures the amount of unsteady work done by the air on the system, when the system is vibrating in one of its natural modes In neutrally stable systems, the unsteady work done by the air on the blades will balance the work dissipated by friction and by material damping An accurate prediction of the vibrational deflections and of the unsteady aerodynamic forces is required at every spanwise location on each blade, so that the work done by the unsteady aerodynamic forces may be calculated Recent progress is described in the prediction of unsteady aerodynamic forces and the determination of mode shapes The stability model is applied to the prediction of supersonic flutter, chordwise bending flutter, and stall flutter (Author)

A75-34132 # Blade vibration - Some key elements in design verification C E Danforth *(U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif , Sept 3-6, 1974) Journal of Aircraft,* vol 12, Apr 1975, p 333-342 5 refs

The paper outlines in some detail two key considerations (1) the assessment at a given operating point of compressor and fan blade vibration in relation to high-cycle fatigue, and (2) the identification of engine operating points worst for blade vibration An illustrative distillation is given of hitherto unpublished per-spectives in blade stress, dynamics, and their experimental sensing as required for effective design and validation of modern blading A deliberate effort is made to illustrate design and design verification significance of blade dynamics, and increasingly three-dimensional stress distributions and levels as derived from precision experiments and massive numerical analysis investigations For example, local time-average stresses three times elementary treatment levels, as generated by the interaction of blade twist, camber, and rim overhang, are indirectly capable of causing fatigue failures, attrib-utable to nonexistent 'mystery' vibration The effectiveness of design verification in extensive simulated flight tests can be enhanced by a systematic identification of operating conditions 'worst' for blade vibration Illustrative examples are given for blade vibration, both stable and self-excited (Author)

A75-34134 # F100 fan stall flutter problem review and solution J D Jeffers, II and C E Meece, Jr (United Aircraft Florida Research and Development Center, West Palm Beach, Fla) *(U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif , Sept 3-6, 1974) Journal of Aircraft,* vol 12, Apr 1975, p 350 357 6 refs

An experimental investigation was conducted to examine an airfoil durability problem in the first fan rotor of the F100 engine This study incorporated laboratory and simulated engine flight tests, an empirical correlation of aeroelastic stability parameters from engine test data, and substantiation testing of the redesign The results of this investigation's initial testing showed that rotor failure at high-flight Mach numbers and low altitudes was caused by torsional stall flutter instability The results of the empirical correlation indicated that a design free of flutter required a decrease in both normalized incidence and reduced velocity Further, the correlation indicated that the flutter was affected by inlet pressure, a heretofore undocumented phenomenon The results of the sub-stantiation testing confirmed that the redesign made the rotor flutter-free throughout the entire aircraft flight envelope It was concluded that an improved stall flutter analysis was required to ensure stable fan and compressor rotor designs (Author)

A75-34137 # Turbine Engine Structural Integrity Program /ENSIP/ W D Cowie (USAF, Aeronautical Systems Div, Wright Patterson AFB, Ohio) (U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif, Sept 3-6, 1974) Journal of Aircraft, vol 12, Apr 1975, p 366 369

The Turbine Engine Structural Integrity Program (ENSIP) was established by the Air Force to provide the framework from which an engine contractor can derive a well-ordered structural development program to meet Air Force needs ENSIP's background and highlights are presented as well as the concept details Some effects of the concept on existing programs are discussed The paper is concluded with a brief list of new criteria which are under consideration to refine or update the present program (Author)

A75-34139 # Low-cycle fatigue and creep analysis of gas turbine engine components S Majumdar (Argonne National Laboratory, Argonne, Ill) (U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif, Sept 3-6, 1974) Journal of Aircraft, vol 12, Apr 1975, p 376-382

The factors that determine the damage of aircraft engines due to low cycle fatigue and creep during service are the numbers and rate of transient acceleration and deceleration, operating ambient temperature, time at temperature, and amount of time at over temperatures The present paper attempts to define a method for predicting this engine damage and establishing the critical engine parameters to be monitored in conjunction with either an on-board computer or a suitable recording system that can be used on a central computer at the conclusion of a flight An analytical study is made of a typical fan engine to show the important engine operating parameters leading to limiting the useful engine life due to (1) low-cycle fatigue in the fan turbine disk and (2) the combination of low-cycle fatigue and creep in the high-pressure turbine blades and vanes The leading edge of both the high-pressure turbine blade and the inlet vane was found to be a critical element The analysis shows that stress concentration due to the presence of cooling holes in the blade should be examined for low-cycle fatigue failure (Author)

A75-34140 # Fracture failure modes in lightweight bearings J C Clark (General Electric Co, Cincinnati, Ohio) (U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif, Sept 3-6, 1974) Journal of Aircraft, vol 12, Apr 1975, p 383-387 6 refs

A series of sixteen bearings operated with tensile stresses in the races were analyzed for cracks Ten of the sixteen bearings generated cracks of critical size resulting in rapid fracture of the races From these data, an estimate is made of the critical stress intensity factor for AISI 52100 and AISI M-50, the materials currently used in aircraft engine bearings Flaws are generated in the races apparently due to a combination of tensile hoop stress and the superimposed Hertz stress pattern An attempt was made to correlate the flaw size and shape to the known stress field, or components of the stress field, but currently these have not been completely successful Using relatively simple, established fracture-mechanics techniques, a limiting stress level can be determined for a given flaw size, but experimental data must be relied upon to predict the flaw size, particularly the depth of the flaw By proper design, the stresses can be maintained at sufficiently low levels to preclude rapid fracture in the outer races The area of concern arises in engines of the future with increased rotor speeds which will generate high hoop stresses in the bearing inner races (Author)

A75-34141 # Analysis of rotor fragment impact on ballistic fabric engine burst containment shields J H Gerstle (Boeing Commercial Airplane Co, Seattle, Wash) (U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif, Sept 3-6, 1974) Journal of Aircraft, vol 12, Apr 1975, p 388 393 20 refs

As a step toward a better understanding of engine burst containment and ascertaining practical shield requirements, a large deflection shell computer program has been modified to model fragment impact, simultaneously calculate the motion of the fragment and shield and predict perforation Recent test data indicates that substantial savings in engine burst containment shield weight may be possible by the use of ballistic fabrics In metal shields the dissipation of fragment kinetic energy is due to compressive and shear deformation in the impact region followed by extensive bending and stretching deformation due to structural excitation In contrast, a fabric shield dissipates the energy almost wholly by tensile deformation The mechanical energy is distributed relatively rapidly throughout the shield as a result of the fabric's high wave speed and membrane response Encouraging results were found in analytical comparisons with experimental data (Author)

A75-34142 # Design of fabricated static structures for long cyclic life A Coles, C K Coombs, and H G Popp (General Electric Co, Cincinnati, Ohio) (U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif, Sept 3 6, 1974) Journal of Aircraft, vol 12, Apr 1975, p 394-399

High performance, lightweight jet engines, which are designed for relatively low cost production and long life requirements, place stringent restrictions on material utilization Static structure design criteria require that tensile, creep, and cyclic life limits be met However, the long operational lifetimes require increased accuracy and reliability of material data and analysis methods In addition, the widespread use of welded sheet fabricated structures has emphasized the need for quality control of manufacturing processes and for a viable defect-tolerance approach to cyclic life prediction A design method which is based on the fracture mechanics approach is presented Both material and geometric imperfections are considered, and guidelines are presented to achieve safe lifetimes for lightweight welded structures (Author)

A75-34143 # Turbine airfoil life prediction by mission analysis M T Loferski (United Aircraft Corp, Pratt and Whitney Aircraft Div, East Hartford, Conn) (U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif, Sept 3-6, 1974) Journal of Aircraft, vol 12, Apr 1975, p 400-402

Increasing design complexity and cost have required an accurate life-prediction technique which would possess rapid computation time and still account for the life-determining variables A method is described which analyzes the life expectancy of turbine parts by simulating airplane and engine performance, and incrementally calculating heat transfer and loading on those parts This method has been successfully used to predict life in field service and to develop turbine hardware through accelerated endurance testing Future applications of the mission analysis are described for real-time prediction systems and maintenance planning (Author)

A75-34146 # Dynamic simulator for advanced gas turbine engine component tests R A Cundiff, R H Badgley (Mechanical Technology, Inc, Latham, N Y), and J Reddecliff (United Aircraft Corp, Pratt and Whitney Aircraft Div, West Palm Beach, Fla) (U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif, Sept 3-6, 1974) Journal of Aircraft, vol 12, Apr 1975, p 423-430 11 refs Contract No F33615-72-C-1801

A rotor-bearing system has been designed and manufactured to be dynamically representative of an entire class of gas-turbine engines the two-spool front-drive, power-turbine engine, which is widely used in helicopter applications The test-rig configuration, with the addition of low-pressure compressor and fan simulator disks, would be dynamically representative of the turbojet and turbofan classes of engines, respectively The apparatus has been utilized for initial evaluation of air-lubricated intershaft foil bearings,

and for demonstration of an advanced balancing procedure For these tests, the shaft was operated on elastically-mounted ball bearings without support damping over a speed range encompassing two bending critical speeds Rotor balancing via the recently-developed multiplane-multispeed balancing procedure was used to suppress both the first bending critical speed and a pedestal resonance, and to leave a distinct vibration peak at the second bending critical speed An air-lubricated intershaft foil bearing of the hydrodynamic, resiliently-supported type proved to be capable of raising the second critical speed above the normal operating speed range of the power turbine shaft (Author)

A75-34147 # Systematic development testing for engine structural integrity assurance E M Spear and R F French (General Electric Co, Cincinnati, Ohio) *(U S Air Force, U S Navy, U S Army, and NASA, Symposium on Propulsion System Structural Integration and Engine Integrity, Monterey, Calif, Sept 3 6, 1974) Journal of Aircraft,* vol 12, Apr 1975, p 431-436

The primary objectives of General Electric's development test programs are to verify the basic design and then demonstrate that the engine, including the individual components, has adequate life and integrity under all operating conditions to which it could be exposed in customer service The successful attainment of these objectives requires balanced test programs The programs must consider all phases of testing from the initial preliminary design models through flight testing of the engine Emphasis is placed on real life operating environment and accelerated life testing The paper discusses General Electric's approach to systematic test planning Examples of these programs from preliminary design components through engine life and reliability demonstrations are provided (Author)

A75-34186 * # Use of numerically generated body fitted coordinate systems for solution of the Navier-Stokes equations J F Thompson, C W Mastin (Mississippi State University, Mississippi State, Miss), F C Thames (LTV Aerospace Corp, Dallas, Tex), and S P Shanks In Computational Fluid Dynamics Conference, 2nd, Hartford, Conn, June 19, 20, 1975, Proceedings
New York, American Institute of Aeronautics and Astronautics, Inc, 1975, p 68-80 11 refs Grant No NGR-25-001 055, Contract No N00014-74-C-0373-P0001

A procedure for numerical solution of the time-dependent, two-dimensional incompressible Navier-Stokes equations that can treat the unsteady laminar flow about bodies of arbitrary shape, such as two-dimensional airfoils, multiple airfoils, and submerged hydrofoils, as naturally as it can deal with the flow about simple bodies The solution is based on a method of automatic numerical generation of a general curvilinear coordinate system with coordinate lines coincident with all boundaries of a general multiconnected region containing any number of arbitrarily shaped bodies The curvilinear coordinates are generated as the solution of two elliptical partial differential equations with Dirichlet boundary conditions, one coordinate being specified to be constant on each of the boundaries, and a distribution of the other being specified along the boundaries The solution compares excellently with the Blasius boundary layer solution for the flow past a semiinfinite flat plate S J M

A75-34190 * # Computational procedure for three-dimensional boundary layers on aircraft and aerospace vehicles R M Kendall, W S Bonnett, C T Nardo, and M J Abbett (Acurex Corp, Mountain View, Calif) In Computational Fluid Dynamics Conference, 2nd, Hartford, Conn, June 19, 20, 1975, Proceedings
New York, American Institute of Aeronautics and Astronautics, Inc, 1975, p 113 123 10 refs Contract No NAS1 12424

An implicit numerical procedure is developed to solve the full three-dimensional laminar, boundary layer equations over realistic aircraft and spacecraft configurations This procedure utilizes splined functions in the direction normal to the surface and finite differences in the cross flow direction Calculation of off-pitch plane attachment

and detachment lines can be calculated The solution procedure permits the incorporation of a wide variety of turbulent models and boundary conditions including entropy layer procedures, specified surface temperatures or heat flux distributions, surface catalysis, mass addition, and the coupling to both three-dimensional inviscid codes and surface ablation codes In addition, reasonable computing times are obtained (Author)

A75-34193 * # Transonic potential flow calculations using conservation form A Jameson (New York University, New York, N Y) In Computational Fluid Dynamics Conference, 2nd, Hartford, Conn, June 19, 20, 1975, Proceedings
New York, American Institute of Aeronautics and Astronautics, Inc, 1975, p 148-161 21 refs Grants No NGR 33-016-167, No NGR-33-016-201, Contract No AT(11-1) 3077

A method is presented for the solution of the full potential equation in conservation form This assures that a weak solution satisfying proper isentropic jump conditions is obtained, giving an improved representation of shock waves in comparison with earlier nonconservative schemes The method uses the concept of artificial viscosity to produce a stable difference scheme in the supersonic zone, and artificial time to generate a convergent iterative scheme for the solution of the difference equations Results of calculations using the nonconservative and conservative schemes are compared (Author)

A75-34194 * # A fast semidirect method for computing transonic aerodynamic flows E D Martin (NASA, Ames Research Center, Computational Fluid Dynamics Branch, Moffett Field, Calif) In Computational Fluid Dynamics Conference, 2nd, Hartford, Conn, June 19, 20, 1975, Proceedings
New York, American Institute of Aeronautics and Astronautics, Inc, 1975, p 162-174 40 refs

A fast, semidirect, iterative computational method, previously introduced for finite difference solution of subsonic and slightly supercritical flow over airfoils, is extended both to apply to strongly supercritical conditions and to include full second order accuracy in computing inviscid flows over airfoils The nonlinear small-disturbance equations are solved iteratively by a direct, linear, elliptic solver General, fully conservative, type dependent difference equations are formulated, including parabolic- and shock-point transition operators that provide consistency with the integral conservation laws These equations specialize to either first-order or to fully second-order-accurate equations Various free parameters are evaluated for rapid convergence of the first-order scheme Resulting pressure distributions and computing times are compared with the improved Murman Cole line relaxation method (Author)

A75-34195 * # Transonic airfoil analysis and design using Cartesian coordinates L A Carlson (Texas A & M University, College Station, Tex) In Computational Fluid Dynamics Conference, 2nd, Hartford, Conn, June 19, 20, 1975, Proceedings
New York, American Institute of Aeronautics and Astronautics, Inc, 1975, p 175-183 18 refs Grant No NGR 44-001 157

An inverse numerical technique for designing transonic airfoils having a prescribed pressure distribution is presented The method uses the full potential equation, inverse boundary conditions, and Cartesian coordinates It includes simultaneous airfoil update and utilizes a direct-inverse approach that permits a logical method for controlling trailing edge closure The method can also be used for the analysis of flowfields about specified airfoils Comparison with previous results shows that accurate results can be obtained with a Cartesian grid Examples show the application of the method to design aft-cambered and other airfoils specifically for transonic flight (Author)

A75 34196 * # Computer simulation of transonic flow past airfoils with boundary layer correction F Bauer and D Korn (New York University, New York, N Y) In Computational Fluid Dynamics Conference, 2nd, Hartford, Conn , June 19, 20, 1975, Proceedings New York, American Institute of Aeronautics and Astronautics, Inc , 1975, p 184 204 15 refs Grant No NGR-33 016-167, Contract No AT(11-1) 3077

A computer program has been developed to solve the compressible flow equation for the velocity potential The exterior of the airfoil is mapped onto the unit circle and the flow is computed on a grid in the circle plane A relaxation method using backward differencing in the flow direction at supersonic points permits solutions for large supersonic areas The pressure distribution resulting from the flow becomes the input to the von Karman momentum equation which when integrated gives the displacement thickness This displacement thickness is smoothed and added to the airfoil to account for the turbulent boundary layer The boundary layer correction is computed iteratively with the flow Results from this program and test data agree well (Author)

A75-34203 The effect of water path variations on ultrasonic through-transmission sensitivity C J Palmer (McDonnell Aircraft Co , St Louis, Mo) (American Society for Nondestructive Testing, National Fall Conference, Detroit, Mich , Oct 21-24, 1974) Materials Evaluation, vol 33, June 1975, p 128-132, 134

The through-transmission C-scan method employing focused search units in squirter nozzles is used to ultrasonically inspect vertical, rudder and horizontal stabilator torque boxes for typical fighter aircraft as well as composite wing skins for development programs Figure 1 shows the location of the composite assemblies on the aircraft The ultrasonic test is applied in addition to film radiography to detect disbonds and other anomalies in these honeycomb structures that have airfoil shapes The purpose of this study is to evaluate the effect of variations of water path on the relative size or sensitivity of the C-scan images obtained using this ultrasonic test method (Author)

A75-34245 # A method for calculating flows through plane airfoil lattices (Ob odnom sposobe rascheta obtekaniia ploskikh reshetok profilei) G I Chmyr', A Sh Asaturian, and A M Kuzemko (Zaporozhskii Mashinostroitel'nyi Institut, Zaporozhe, Ukrainian SSR) Prikladnaia Mekhanika, vol 11, Apr 1975, p 83-88 7 refs In Russian

In the method proposed, the computation of the flow through a plane cascade is reduced to solving an integral equation A method, termed the method of averaging functional corrections, proposed for solving the equation provides analytical expressions for the velocity potential and for the velocity of the potential flow through the cascade Analytical representation of the blade profile (required in the application of the method) is obtained with the aid of Chebyshev polynomials A numerical example problem is solved on a computer V P

A75-34262 # Calculation of the separated flow at a thin-section wing of finite span (Raschet otryvnogo obtekaniia tonkogo kryla konechnogo razmakha) S M Belotserkovskii, M I Nisht, and O N Sokolova Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza, Mar -Apr 1975, p 107-112 8 refs In Russian

Approaches proposed by Belotserkovskii (1968, 1974) to the solution of steady and unsteady nonlinear problems involving attached flows are adapted to the analysis of separated flows at wings of arbitrary planform Motions of a thin lifting surface in an incompressible medium, accompanied by the trailing off of vortex sheaths both from the trailing and leading edges are examined V P

A75-34272 # General analysis of the diffraction pattern for a plane acoustic wave at a wedge moving at supersonic speed (Obshchii analiz kartiny difraktsii ploskoi akusticheskoi volny na kline, dvizhushchemsia so sverkhzvukovoi skorosti'iu) A V Panasenko Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza, Mar -Apr 1975, p 172-175 5 refs In Russian

A75-34299 # Aircraft dynamics - What pilots never ask J D Erickson (FAA, Southwest Regional Office, Fort Worth, Tex) AIAA Student Journal, vol 13, Spring 1975, p 10-13

Dynamic testing of aircraft response is examined Methods are described for exciting, observing, and recording phygoid response and short-period oscillation as well as the roll, spiral, and Dutch-roll modes Acceptable damping ratios are provided, and precautions are given for conducting the tests using pilot-induced control displacements F G M

A75-34535 * Simulator evaluation of manually flown curved MLS approaches D Sager (Mitre Corp , McLean, Va) In International Conference on Systems, Man, and Cybernetics, Dallas, Tex , October 2 4, 1974, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc , 1974, p 104-109 Grant No NGL 22 009 640

Pilot performance in flying horizontally curved instrument approaches was analyzed by having nine test subjects fly curved approaches in a fixed base simulator Approaches were flown without an autopilot and without a flight director Evaluations were based on deviation measurements made at a number of points along the curved approach path and on subject questionnaires Results indicate that pilots can fly curved approaches, though less accurately than streight in approaches, that a moderate wind does not seriously affect curve flying performance, and that there is no major performance difference between 60 and 90 deg turns (Author)

A75-34536 International and U S design proposals for a microwave landing system S A Meer and S R Jones (Mitre Corp , McLean, Va) In International Conference on Systems, Man, and Cybernetics, Dallas, Tex , October 2 4, 1974, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc , 1974, p 150-160 8 refs

This paper describes the preliminary designs being proposed to the International Civil Aviation Organization (ICAO) by the five countries having development programs on a new precision approach and landing system The Australian, U K and U S Systems are all 'air derived' and use the C-Band for the main functions of azimuth and elevation Differences in these designs exist both in the use of Doppler or scanning beam concepts and in the use of time or frequency multiplexing of the azimuth and elevation signals The French and German designs derive the angle information on the ground and transmit it to the aircraft via a data link The French are proposing either an interferometric or a Doppler-effect reception technique, while the German approach is to employ the L-B and DME The signal formats, ground systems, and avionics features of each design are described Design parameters that influence system performance in terms of accuracy, integrity and implementability are identified (Author)

A75-34537 Involving the expert and aviation community in the decision making structure of the U S MLS program G Jensen (FAA, Systems Research and Development Service, Washington, D C) In International Conference on Systems, Man, and Cybernetics, Dallas, Tex , October 2 4, 1974, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc , 1974, p 161 165 5 refs

This paper describes the decision making structure being used to define the U S microwave landing system (MLS) design that will be

offered to the International Civil Aviation Organization for con sideration as the new standard replacing the existing instrument landing system (ILS) Essential prerequisites of such an offering include thoroughness in the underlying technical work and agree ment by the user community that the new system is responsive to its diverse requirements in a cost effective manner The basic charac- teristics of a landing system are determined by the technique on which it is based and the design of the signal structure (signal format) Wide acceptance of a system requires that the development and user groups mutually agree on these fundamental design choices This calls for open, participative communication between these groups while the system decisions are being made   (Author)

A75-34539   Air traffic controllers' operative effectiveness under NAS environments W Siddiqee, G J Coulurls, and D K Schmidt (Stanford Research Institute, Menlo Park, Calif) In International Conference on Systems, Man, and Cybernetics, Dallas, Tex, October 2-4, 1974, Proceedings   New York, Institute of Electrical and Electronics Engineers, Inc, 1974, p 175-179

In this paper the usefulness of various features of national airspace system (NAS) stage A   e g, automated flight data processing, automatic altitude reporting (mode C), automated radar target tracking and automatic handoff capabilities in enhancing the effectiveness of controllers in the air route traffic control centers (ARTCC) is critically reviewed Aspects of failure effect considera- tions that may limit a controller's effectiveness are discussed Results of a few field measurements and interviews with controllers are also reported Recommendations are made that might be helpful in improving further effectiveness of controllers   (Author)

A75-34566 * #   Three dimensional characteristics of turbulent wakes behind rotors of axial flow turbomachinery R Raj and B Lakshminarayana (Pennsylvania State University, University Park, Pa) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex, Mar 2-6, 1975, Paper 75-GT-1* 10 p 12 refs Members, S1 00, nonmembers, S3 00 Contract No NAS3-17855

A75-34567 #   Ground vortex - Limit to engine/reverser operation D L Motycka (United Aircraft Corp, Pratt and Whitney Aircraft Div, East Hartford, Conn) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex, Mar 2 6, 1975, Paper 75-GT-3* 6 p Members, S1 00, nonmembers, $3 00

It has been commonly accepted that engine stalls during reverser operation are caused by the temperature distortion created by reingested exhaust gases Recent studies have shown that com- pressors respond to instantaneous inlet distortions of a time duration on the order of one engine revolution This paper describes the results of a test of a high bypass ratio engine during reverse thrust operation which revealed, through the use of high response tempera- ture and pressure measurement, that instantaneous distortions caused by an induced ground vortex were the cause of engine stalls
                                                        (Author)

A75-34570 #   Experimental investigation of a new concept of fuel prevaporization G Kappler, G Kirschey, and A Fehler (Munchen Technische Hochschule, Munich, West Germany) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex, Mar 2 6, 1975, Paper 75-GT-6* 4 p 12 refs Members, S1 00, nonmembers, S3 00

The established emission standards for aircraft engines require the development of low emission combustors which incorporate new concepts of fuel prevaporization and premixing systems At MTU- Muenchen a fuel injection system was designed which greatly suppresses droplet combustion and avoids burning at stoichiometric

air fuel ratios Thereby the large quantities of NO produced at adiabatic peak temperatures are omitted and soot formation as a result of low velocity droplet combustion is avoided Tests with a combustor incorporating the fuel injection system yielded high combustion efficiencies, improved combustor outlet temperature distributions and low pollutant emissions Comparing the measured emission indices for CO, NO, and unburned HC with values required for civil aircraft engines showed a promising development potential of achieving the standards   (Author)

A75 34573 #   Surge and rotating stall in axial flow com pressors I   Theoretical compression system model E M Greitzer (United Aircraft Corp, Pratt and Whitney Aircraft Div, East Hartford, Conn) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex, Mar 2 6 1975, Paper 75-GT-9* 9 p 13 refs Members, S1 00, nonmembers, S3 00

This paper reports a theoretical study of axial compressor surge A nonlinear model is developed to predict the transient response of a compression system subsequent to a perturbation from steady operating conditions It is found that for the system investigated there is an important nondimensional parameter on which this response depends Whether this parameter is above or below a critical value determines which mode of compressor instability, rotating stall or surge, will be encountered at the stall line For values above the critical, the system will exhibit the large amplitude oscillatory behavior characteristic of surge, while for values below the critical it will move toward operation in rotating stall, at a substantially reduced flow rate and pressure ratio Numerical results are presented to show the motion of the compression system operating point during these two basic modes of instability, and a physical explanation is given for the mechanism associated with the genera- tion of surge cycle oscillations   (Author)

A75-34575 * #   Rotor burst protection program - Statistics on aircraft gas turbine engine rotor failures that occurred in U S commercial aviation during 1973 G J Mangano and R A DeLucia (U S Naval Air Propulsion Test Center, Trenton, N J) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex, Mar 2-6, 1975, Paper 75 GT-12* 4 p Members, $1 00, nonmembers, S3 00 NASA-sponsored research

This paper presents statistical information on the aircraft gas turbine engine rotor failures that occurred in U S commercial aviation during 1973 Based on F AA data, results are presented that establish (1) the incidence of rotor failure, (2) the type of fragments generated, (3) whether or not these fragments were contained, (4) the causes of failure, (5) where in the engine failure occurred, (6) what engines were affected, and (7) what flight conditions prevailed at failure The rate of uncontained rotor burst was considered to be significantly high   (Author)

A75-34576 #   Study on the mechanism of stall margin improvement of casing treatment H Takata (Tokyo, University, Tokyo, Japan) and Y Tsukuda (Mitsubishi Heavy Industries, Ltd, Takasago, Hyogo, Japan) *American Society of Mechanical En gineers, Gas Turbine Conference and Products Show, Houston, Tex, Mar 2 6, 1975, Paper 75-GT-13* 16 p 6 refs Members, S1 00, nonmembers, S3 00

An experiment on the effect of casing treatment was made using a low-speed axial-flow compressor equipped with a single rotor Results on the overall compressor performance and on the flow through the blade row as well as the flow within the treatment slots are presented Then, based on the experiment, possible mechanisms of the stall margin improvement are suggested   (Author)

A75-34580 # The refracting inlet - A new concept for aircraft inlet noise suppression D Sloan and B W Farquhar (Boeing Co , Propulsion Research Group, Renton, Wash) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex , Mar 2-6, 1975, Paper 75-GT-21* 11 p 5 refs Members, $1 00, nonmembers, $3 00

Observations of wave refraction in flowfields containing large transverse velocity gradients have suggested a means by which refraction effects could be used to aid suppression of the noise propagating forward through aircraft gas turbine inlets The first part of this paper describes an experiment using a schlieren apparatus to observe waves passing through inlet-type flowfields The second part describes a test program using model inlets to examine the feasibility of the refracting inlet concept (Author)

A75-34586 # Performance development of the Gem turbo-shaft engine A B McKenzie, B T Bayne (Rolls Royce/1971/, Ltd , Leavesden, Herts , England) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex , Mar 2 6, 1975, Paper 75-GT 28* 9 p Members, $1 00, nonmembers, $3 00 Research supported by the Ministry of Defence (Procurement Executive)

The Gem engine considered was specifically designed for a helicopter application The engine has a two shaft gas generator There are altogether three concentric shafts, including the power turbine shaft, the low-pressure gas generator shaft, and the high pressure gas generator shaft Questions of component performance development are discussed along with aspects of component match ing and details regarding the development of engine performance
G R

A75-34588 # Preliminary study of low emission gas turbine combustor with airblast fuel atomizer K Yamanaka and K Nagato (Ishikawajima Harima Heavy Industries Co , Ltd , Tanashi, Japan) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex , Mar 2-6, 1975, Paper 75-GT 31* 8 p 7 refs Members, $1 00, nonmembers, $3 00

An airblast fuel injection tube (AFIT) for gas turbine engines is reported in which fuel is broken up into droplets by atomizing air from several small holes on the tube wall and is mixed well with the air immediately at the hole outlets Design considerations for the AFIT are described, and results are reported for atomization and combustion tests as well as for the measurement of exhaust emissions It is shown that the AFIT can fully atomize fuel using only the discharge of compressed air and has a higher combustion efficiency than the pressure atomizer even at low engine speeds The NOx emission level of the AFIT is found to be lower than that of the pressure atomizer and to satisfy EPA regulations, while the CO emission level is found also to be lower than that of the pressure atomizer but not to meet the EPA standards It is noted that the CO emission level can be reduced by an even further suitable arrange ment of the injection holes F G M

A75-34592 # Influences of manufacturing tolerances and surface roughness of blades on the performance of turbines K Bammert and H Sandstede (Hannover, Universitat, Hanover, West Germany) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex , Mar 2-6, 1975, Paper 75-GT-35* 8 p 11 refs Members, $1 00, nonmembers, $3 00

The costs of the manufacturing of turbine blades are very dependent on the manufacturing tolerances and the quality of the surface A good performance of a turbine needs a certain smoothness of the surface and small tolerances For an optimisation of the costs it is necessary to know the influences of roughness and tolerances on the performance of a turbine In our institute measurements were carried out with thinned and thickened blades mounted in a turbine, which represents different manufacturing tolerances In addition,

measurements on a turbine with roughened blades were done From these measurements a conclusion on the aerodynamical and thermo dynamical behavior of the turbine is obtained The paper gives a summary of the measurements and shows how the performance of a turbine is affected by the roughness and the profile tolerances
(Author)

A75-34597 # Experiments concerning the response of super sonic nozzles to fluctuating inlet conditions E E Zukoski (California Institute of Technology, Pasadena, Calif) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex , Mar 2 6, 1975, Paper 75-GT-40* 5 p Members, $1 00, nonmembers, $3 00

The noise field produced by the passage of pressure and entropy fluctuations through a supersonic nozzle has been investigated in an experimental program Magnitude and phase information for the disturbances produced within the nozzle are presented and are compared with numerical calculations (Author)

A75-34604 # Missile firing tests at stationary targets in support of blade containment design J I Goatham and R M Stewart (Rolls-Royce /1971/, Ltd , Derby, England) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex , Mar 2 6, 1975, Paper 75-GT-47* 6 p Members, $1 00, nonmembers, $3 00 Research supported by the Ministry of Defence (Procurement Executive)

Compressor and turbine blades of aircraft engines are liable to failure from a number of causes Their subsequent containment within the immediate confines of the engine has long posed problems for the designer aiming for minimum weight designs To assist the understanding of the dynamics of the containment problem, a series of small scale model tests have been conducted The particular tests reported, deal with the failure mechanism at the point of impact A theoretical analysis in support of the results obtained is developed Fairly good agreement is obtained between tests and theory and the read-across to full scale containment tests indicates that the containment problem is capable of scaling if linear velocities are kept constant A discontinuity in the behavior of materials with respect to their just contained energy capacity has been identified While several contributory factors can be suggested, a fully satisfactory explana tion is not found (Author)

A75-34612 # Propagating stall in compressors with porous walls J H Horlock and C M Lakhwani (Salford, University, Salford, England) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex , Mar 2-6, 1975, Paper 75-GT-59* 9 p 7 refs Members, $1 00, nonmembers, $3 00

A modification is presented to the Emmons/Stenning analysis for predicting stall propagation, taking into account the unsteady flow through the end wall of a cascade row of compressor blades It is shown that if radial flow from the blade channels is permitted, then the condition for flow instability is changed The expression obtained for the flow coefficient at which stall occurs indicates an improvement in operating range, with virtually no effect on stall cell speed Experimental evidence suggests that a mechanism such as that described may be the reason for the delay in stall onset produced by porous wall treatment of axial compressors (Author)

A75-34613 * # A study of casing treatment stall margin improvement phenomena D C Prince, Jr , D C Wisler, and D E Hilvers (General Electric Co , Aircraft Engine Group, Cincinnati, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex , Mar 2-6, 1975, Paper 75-GT 60* 13 p 9 refs Members, $1 00, nonmembers, $3 00 Contract No NAS3 15707

The results of a program of experimental and analytical research

in casing treatments over axial compressor rotor blade tips are presented Circumferential groove, axial skewed slot and blade angle slot treatments were tested at low speeds With the circumferential groove treatment the stalling flow was reduced 5 8% at negligible efficiency sacrifice The axial skewed slot treatment improved the stalling flow by 15 3%, 1 8 points in peak efficiency were sacrificed The blade angle slot treatment improved the stalling flow by 15 0%, 1 4 points in peak efficiency were sacrificed The favorable stalling flow situations correlated well with observations of higher than-normal surface pressures on the rotor blade pressure surfaces in the tip region, and with increased maximum diffusions on the suction surfaces Annulus wall pressure gradients, especially in the 50 to 75% chord region, are also increased and blade surface pressure loadings are shifted toward the trailing edge for treated configurations

(Author)

A75-34614 # Excess noise from gas turbine exhausts N A Cumpsty (Cambridge University, Cambridge, England) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex , Mar 2-6, 1975, Paper 75-GT-61* 10 p 6 refs Members, $1 00, nonmembers, $3 00

There is evidence to show that the exhaust noise from gas turbines contains components which exceed the jet mixing noise at low jet velocities This paper describes a theory developed to calculate the acoustic power produced by temperature fluctuations from the combustor entering the turbine Using the turbine Mach numbers and flow directions at blade mid height, and taking a typical value for the fluctuation in temperature, it has been possible to predict the acoustic power due to this mechanism for three different engines In all three cases the agreement with measurements of acoustic power at low jet velocities is very good Using a measured spectrum of the temperature fluctuation the prediction of the *acoustic power spectrum agrees quite well with that measured*

(Author)

A75-34617 # Unsteady boundary layers over rotating blades R S R Gorla (Chrysler Corp , Detroit, Mich) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex , Mar 2 6, 1975, Paper 75-GT-64* 9 p 12 refs Members, $1 00, nonmembers, $3 00

Rotating blades provide some of the most challenging problems of fluid mechanics The presence of secondary effects in the boundary layers over rotating blades results in the flow and heat transfer characteristics that are different from the classical two-dimensional boundary layer theory In this paper, the unsteady velocity and thermal boundary layers have been solved for constant temperature boundary condition By the use of small crossflow approximation, a perturbation analysis is developed to predict heat transfer characteristics Numerical results for the universal functions proportional to primary flow and crossflow are presented For the thermal problem, universal functions are presented for $Pr = 0 70$ and 1 0 Expressions for the skin friction coefficient as well as the Nusselt number have been derived (Author)

A75 34627 * b Structural response of fiber composite fan blades C C Chamis (NASA, Lewis Research Center, Materials and Structures Div , Cleveland, Ohio) and M D Minich (Cleveland State University, Cleveland, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston Tex , Mar 2-6, 1975, Paper 75 GT 78* 20 p Members, $1 00 nonmembers, $3 00

A fiber composite airfoil, typical for high-tip speed compressor applications, is subjected to load conditions anticipated to be encountered in such applications, and its structural response is theoretically investigated The analysis method used consists of composite mechanics embedded in pre and post processors and coupled with NASTRAN The load conditions examined include thermal due to aerodynamic heating, pressure due to aerodynamic forces, centrifugal, and combinations of these The various responses

investigated include root reactions due to various load conditions, average composite and ply stresses, ply delaminations, and the fundamental modes and the corresponding reactions The results show that the thermal and pressure stresses are negligible compared to those caused by the centrifugal forces Also, the core shell concept for composite blades is an inefficient design (core plies not highly stressed) and appears to be sensitive to interply delaminations The results are presented in graphical and tabular forms to illustrate the types and amount of data required for such an analysis, and to provide quantitative data of the various responses which can be helpful in designing such composite blades (Author)

A75-34628 # A fracture mechanics approach to turbine airfoil design I Linask and J Dierberger (United Aircraft Corp , Pratt and Whitney Aircraft Div , East Hartford, Conn) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston Tex , Mar 2-6, 1975, Paper 75-GT-79* 8 p 8 refs Members, $1 00, nonmembers, $3 00 Contract No N00029 73-C-0021

An analytical study was conducted using fracture mechanics principles to model turbine airfoil cracking it was found that crack initiation can be related to calculated residual strains in the airfoil coating and that coating properties are an important consideration in determining crack location and orientation The coating crack subsequently propagates into base material according to basic fracture mechanics laws A comparison with engine tested blade experience is made It is concluded that the presented model provides a rational method for design life prediction but its general application requires definition of new types of material property information (Author)

A75-34631 , Development of a high-heat-release combustor for the F100 gas turbine T E Holladay, G C Barlow (United Aircraft Corp , Pratt and Whitney Aircraft Div , West Palm Beach, Fla), and R E Henderson (USAF, Aero Propulsion Laboratory, Wright Patterson AFB, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex , Mar 2 6 1975, Paper 75 GT-86* 8 p Members, $1 00, nonmembers, $3 00

The F100 turbofan engine is a twin spool, augmented engine /89,000 133,000 Newton (20-30,000 lb) thrust range/ that powers the McDonnell Douglas/Air Force F 15 air superiority fighter The F100 was developed jointly with the Navy F401 engine These engines have a common core (gas generator) The success of these advanced high thrust/weight engines is, in part, the result of the development of a short, annular, high heat release rate primary combustor, which has a low temperature pattern factor, high combustion efficiency, and low pressure loss The F100's combustor uses conventional sheet metal louver cooling to minimize cost and weight, airblast fuel nozzles and combustor swirlers to atomize the fuel, and a dump diffuser to reduce the compressor air exit Mach number (Author)

A75-34636 # Trailing edge flows over turbomachine blades and the Kutta-Joukowsky condition J P Gostelow (Cambridge University, Cambridge, England) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex , Mar 2-6, 1975, Paper 75 GT-94* 16 p 40 refs Members, $1 00, nonmembers, $3 00 Research supported by the Ministry of Defence (Procurement Executive)

The work of Kutta and Joukowsky on trailing edge conditions is reviewed and the 'Kutta-Joukowsky condition' is stated It is shown that for most turbomachine blades, having a rounded trailing edge, this condition has no meaning and that any meaningful condition must include the effect of viscosity The question of trailing edge conditions in an unsteady flow environment is raised and some low frequency parameter experimental evidence on this question is presented (Author)

A75-34638 # Jet induced thermal effects for VTOL aircraft W A Barron (Grumman Aerospace Corp, Bethpage, N Y) and J L Palcza (U S Navy, Naval Air Propulsion Test Center, Trenton, N J) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex , Mar 2 6, 1975, Paper 75 GT 96* 14 p 16 refs Members, $1 00, nonmembers, $3 00

Thermal effects peculiar to lift/cruise and lift plus lift/cruise VTOL aircraft are evaluated These include jet heating of takeoff surfaces, wall jet effects on aircraft ground operations, fountain impingement heating of aircraft skins, and inlet hot gas reingestion Data on these effects are presented, based on analysis, model tests and airplane operational experience Design features and operational procedures which can minimize possible adverse effects are discussed It is concluded that thermal effects can be of major importance and must be carefully evaluated in the early aircraft design phase and checked by model tests Significant constraints on ground operations and VTOL flight modes will exist for all such aircraft (Author)

A75-34639 # A design study of a fan augmented ramjet E W Beans (Toledo, University, Toledo, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex , Mar 2 6, 1975, Paper 75-GT-97* 11 p 5 refs Members, $1 00, nonmembers, $3 00

The characteristics of a hybrid propulsion system, which fills the gap between turbojets and ramjets, are presented The hybrid system is a fan augmented ramjet and consists of a rambuiner fed by an externally driven low pressure ratio fan Cycle analyses, performance estimates and, scaling relationships for subsonic and supersonic operation, and a preliminary design of a subsonic version are presented A 50 to 100 percent improvement in cruise performance above that of a ramjet can be expected in the subsonic regime (Author)

A75-34640 # Lift fan characteristics selection for 1980-85 V/STOL carrier onboard delivery aircraft R L Cavage (Rockwell International Corp, Los Angeles, Calif) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex , Mar 2-6, 1975, Paper 75 GT 98* 11 p Members, $1 00, nonmembers, $3 00

Characteristics for an optimum lift fan propulsion system for a 1980 1985 Navy V/STOL carrier onboard delivery transport aircraft are developed The potential characteristics and technology projec tions for the propulsion system, the aircraft design objectives and methodology used to select the optimum propulsion system charac teristics are presented The results of trade study comparisons for single- and two-stage fans, design fan pressure ratio, number and arrangement of fans and gas generators, and jet propulsion system effects on aircraft weight and drag are included An artist's concept and design brief of the aircraft resulting from the use of the identified optimum propulsion system are presented (Author)

A75-34642 : Design and analysis of a ceramic stator vane S C Sanday, T L Lam, and T J Raham (Westinghouse Electric Corp, Gas Turbine Systems Div, Lester, Pa) *American Society of Mechanical Engineers Gas Turbine Conference and Products Show, Houston Tex , Mar 2 6, 1975, Paper 75 GT 100* 11 p 6 refs Members, S1 00, nonmembers, S3 00 ARPA supported research

The development of a ceramic stator vane for the first stage of a high temperature industrial gas turbine is presented The elastic transient thermal stress analysis of the latest design, using a three dimensional isoparametric finite element code is outlined Results for a vane assembly made of silicon nitride and exposed to several temperature time conditions are discussed (Author)

A75-34643 # Laboratory testing of controls for aircraft turbine engines J R Baker (United Aircraft Corp, Pratt and Whitney Aircraft Div, East Hartford, Conn) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show,*

Houston, Tex , Mar 2-6, 1975, Paper 75 GT 101 10 p Members, $1 00, nonmembers, $3 00

The conceptual design and feasibility of the closed loop bench test facility (CLB) are discussed The test facility integrates computers (an electrical representation of the real time engine) and appropriate interfacing hardware in order to develop controls in parallel with gas turbine engine development, allowing evaluation of the engine/control interactions independently of the actual engine development cycle The development of a particular CLB is traced from inception to the completion of one capable of representing any engine over its complete operating envelope M G

A75-34650 # Spatial supersonic flow through annular cascades H H Fruehauf (Stuttgart, Universitat, Stuttgart, West Germany) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex , Mar 2-6, 1975, Paper 75-GT 113* 7 p 6 refs Members, $1 00, nonmembers, $3 00

The spatial supersonic flow through rotating and stationary annular cascades is analyzed by means of a nonlinear three dimensional method of characteristics Three dimensional corrections for flow quantities referred to a quasi three-dimensional approximation method are determined depending on geometric and gas dynamical parameters Characteristic properties of spatial super sonic flow through annular cascades are analyzed, leading to guiding principles for practical design purposes (Author)

A75 34653 # Experimental results of full scale air-cooled turbine tests H Nouse, A Yamamoto, T Yoshida, H Nishimura, K Takahara, T Torisaki, and M Matusuki (National Aerospace Laboratory, Tokyo, Japan) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex , Mar 2-6, 1975, Paper 75 GT-116* 11 p 5 refs Members, S1 00, nonmembers, S3 00

In order to investigate several problems associated with the turbine cooling, an air cooled two stage axial flow turbine for an aircraft engine application was designed Aerodynamic characteristics of the two-stage turbine without coolants were obtained first from the cold air turbine tests, and predictions of the turbine performance with supplying of coolants were made using the test results Following these experiments, cooling tests of the first stage turbine were conducted in the range of turbine inlet gas temperatures lower than 1360 K by another test apparatus The descriptions of the turbine and the two test apparatus and the experimental results of the two test turbines are presented The performance prediction, coolant effects and Reynolds number effect on the turbine perfor mance are also described (Author)

A75 34654 # Development of real time high energy X-ray imaging system for use in dynamic fluoroscopy of aero gas turbines A E Stewart (Rolls-Royce /1971/, Ltd , Bristol, England) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Houston, Tex , Mar 2-6, 1975, Paper 75-GT 117* 11 p 12 refs Members, $1 00, nonmembers, $3 00

A75-34661 # Parachute systems of the DFVLR for stabilization and salvage of flight vehicles (Fallschirmsysteme der DFVLR zur Stabilisierung und Bergung von Flugkorpern) K F Doherr and P Hamel (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Flugmechanik, Braunschweig, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Symposium uber Start und Bergeverfahren von Flugkorpern, Hohen raketen und Drohnen, Bremen, West Germany, Apr 30, 1974, Paper 74-043* 40 p 21 refs In German (DFVLR-IB 154 74/13)

Scientific investigations regarding factors related to the opera tion of parachute systems are considered, taking into account dimensional effects, relations between drag and stability, aspects of pressure distribution, parachute strength requirements, free flight model tests, and statistical accident studies Questions concerning the

development and the testing of parachute systems are also discussed Attention is given to special test equipment and installations, parachutes for low jump-off altitudes, rescue systems for the crews of military aircraft including helicopters, systems for the braking and the stabilization of flight vehicles, and various rescue and salvage systems related to space applications   G R

A75-34725 #   System concept and key problems concerning pilotless, remotely-controlled combat aircraft UKF (Systemkonzept und Schlusselprobleme unbemannter, ferngelenkter Kampfflugzeuge UKF) J Spintzyk and P Starke (Dornier GmbH, Friedrichshafen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 7th, Kiel, West Germany, Sept 17-19, 1974, Paper 74 076a* 82 p 19 refs In German

Pilotless, remotely controlled flight vehicles show great promise for combat missions involving strongly defended ground targets An employment of such unmanned aircraft is considered in the case of typical area targets in connection with the provision of air support and missions which have the objective to isolate the combat area A description of the considered vehicle concept is given Key problems are related to target recognition, data transmission, target search at the projection screen, flight control, and vehicle navigation Attention is also given to an experimental system for the study of the various problem areas   G R

A75-34854   A means of dynamic control of radar reflectivity of an antenna or other object by means of a gaseous plasma shroud E A Flick and D J Kozakoff (Martin Marietta Aerospace, Orlando, Fla) In Inventing the model of the future, Proceedings of the Southeast Region 3 Conference, Orlando, Fla , April 29 May 1, 1974   New York, Institute of Electrical and Electronics Engineers, Inc , 1974, p 46-49 10 refs

A technique is proposed for controlling the reflectivity of an antenna by means of a bilateral gaseous plasma shrouding that permits the area shrouded to have dual mode properties and function at different times both as an opaque or transparent medium The low reflectivity of a metal nosed vehicle is attained by generating a sufficiently dense gaseous plasma conforming to the radome interior geometry At frequencies sufficiently below the plasma cutoff frequency, the forward scatter is reduced to that of the metal nosed counterpart until, on demand, the plasma is extinguished, exposing the antennas contained within the dielectric radome   P T H

A75-34884   Passive infrared imaging systems J J Richter (Martin Marietta Aerospace, Orlando, Fla) In Inventing the model of the future, Proceedings of the Southeast Region 3 Conference, Orlando, Fla , April 29 May 1, 1974   New York, Institute of Electrical and Electronics Engineers, Inc , 1974, p 337 340

Passive IR imaging systems are those which employ the sensing of infrared electromagnetic emission with sufficient scanned spatial resolution to obtain a displayed representation of the thermal characteristics of the scene Recent technological advances are described along with the evolution from earlier system configurations Some applications meriting immediate system development include accurate military nighttime fire control aircraft landing aid in heavy IFR conditions, nondestructive monitoring and testing, medical diagnosis, and the like   S D

A75-34975 *   Supercritical wing sections 'I A handbook F Bauer, P Garabedian, D Korn, and A Jameson (New York University, New York, N Y) Research supported by the U S Atomic Energy Commission and NASA, Grants No NGR-33 016-167, No NGR-33 016-201, Contract No AT(11 1) 3077 Berlin and New York, Springer Verlag (Lecture Notes in

Economics and Mathematical Systems Volume 108), 1975 301 p 17 ref S12 10

The numerical aspect of theoretical work on transonics and supercritical wing sections are compiled A model of the trailing edge is introduced which eliminates the loss of 15 to 20 percent experienced with heavily aft loaded models, and it is indicated how drag creep can be reduced at off design conditions A rotated finite difference scheme is presented which can handle supersonic as well as subsonic free stream Mach numbers and leads to an effective three dimensional program for the computation of transonic flow past an oblique wing In the case of two-dimensional flow, the method is extended to take into account the displacement thickness computed by a semiempirical turbulent boundary layer correction A series of supercritical wing sections is discussed together with comparisons between experimental and theoretical data Computer programs and a brief manual for their operation are listed It is shown that the programs furnish a physically adequate computer simulation of the compressible flows that arise in problems of transonic aerodynamics   F G M

A75-35098   Wind tunnel tests for the determination of the behavior of aircraft external loads which are dropped (Windkanalversuche zur Ermittlung des Abwurfverhaltens von Flugzeug Aussenlasten) K Wichmann (Deutsche Forschungs und Versuchsanstalt fur Luft- und Raumfahrt, Zentralabteilung Niedergeschwindigkeits-Windkanale, Porz-Wahn, West Germany) *DFVLR-Nachrichten,* June 1975, p 655, 656 In German

Fighters and combat aircraft carry many external loads It is desired that these loads can be dropped without any hazard for the aircraft during all occurring flight conditions Practical tests involving a demonstration of this capacity are very complex and present certain dangers for the aircraft For these reasons preliminary studies involving a simulation of the actual conditions with the aid of aircraft models are conducted in wind tunnels Details concerning these studies are discussed, giving attention also to the employment of high-speed cameras   G R

A75 35101 #   An axisymmetric separated and reattached flow on a longitudinal blunt circular cylinder T Ota (Akita University, Akita, Japan) *(American Society of Mechanical Engineers, Applied Mechanics Summer Conference, Rensselaer Polytechnic Institute, Troy, N Y , June 23 25, 1975, Paper 75-APM-14) ASME, Transactions, Series E Journal of Applied Mechanics,* vol 42 June 1975, p 311-315 24 refs

Low-speed experiments are made for an axisymmetric separated, reattached, and redeveloped flow over a longitudinal circular cylinder with blunt leading edge The flow characteristics such as the reattachment length and the flow pattern in the separated region are measured The redevelopment of the flow downstream of reattachment is also investigated through various experimental results
                                                              (Author)

A75 35159   Titanium casting - Industrial development - Economic aspects (Moulage du titane Mise au point industrielle - Aspects economiques) P Merrien and A Barbier (Societe Messier, Arudy, Pyrenees-Atlantiques, France) *(Chambre Syndicale des Producteurs d'Aciers Fins et Spéciaux and Union Syndicale des Industries Aéronautiques et Spatiales, Journée d'Etudes, 6th, Le Bourget, Seine-St -Denis, France, June 5, 1975) Matériaux et Techniques,* vol 63, May 1975, p 235-246 In French

A new foundry in France has recently been completed for casting titanium alloy components of aerospace structures The facility possesses tools for high-temperature vacuum degassing of molds, electron beam melting, and casting by centrifugation Some results obtained with this new installation are described, and various economical aspects of the technology used in it are pointed out Two main furnaces are contained in the installation, one with 40 kW and one with 500 kW capacity Properties of the parts fabricated here, due to the intrinsic characteristics of the alloy and to the internal structure that can alter them, are reported in detail   S J M

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A75-35170 # Concurrent mixing and diffusion in three dimensions H Viets and B Quinn (USAF, Aerospace Research Laboratories, Wright Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn, June 16-18, 1975, Paper 75 873* 7 p 7 refs

An experimental study of the effect of direction on the concurrent mixing and diffusion process occurring in three dimensional diffusers is presented The results of two earlier analytical studies which predicted a preferred direction of diffusion are verified A diffuser geometry where the walls diverge normal to the plane of the nonuniform entrance velocity profile results in a larger pressure ratio across the diffuser, increased mixing within the diffuser and the potential to achieve the same performance as alternate designs while employing less driving fluid (Author)

A75-35171 # A perturbation method for transonic flows about oscillating airfoils R M Traci, J L Farr, Jr (Science Applications, Inc, El Segundo, Calif), and E D Albano *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn, June 16-18, 1975, Paper 75-877* 13 p 22 refs Contract No F33615 74 C 3094

A theory and numerical solution method are presented for the problem of two dimensional unsteady transonic flow about thin airfoils undergoing harmonic oscillation The theory is based on a treatment of the unsteady flow as a small perturbation on the nonlinear steady flow The coupled governing equations for the steady and unsteady perturbation potentials are of mixed elliptic/hyperbolic type and are solved using the mixed differencing, line relaxation technique of Murman and Cole Detailed steady and unsteady results are compared to available data and more exact numerical calculations (Author)

A75-35172 # Vortex development and breakdown J Raat (General Dynamics Corp, Convair Div, San Diego, Calif) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn, June 16-18, 1975, Paper 75-881* 18 p 5 refs Contract No F33615 74 C 3084

The process of vortex development and breakdown is analyzed as a function of initial and external aerodynamic conditions A line vortex is assumed which consists of a thin viscous core of laminar flow imbedded in an inviscid flow of uniform circulation and has an axial velocity that may depend on the distance along the core Self similar solutions which exhibit linear core growth are obtained for the particular case of an external velocity inversely proportional to core length The primary mechanism of vortex breakdown is found to involve a fundamental incompatibility of the axial and azimuthal flow modes within the confines of a thin layer and to be due to the existence of upper bounds on the ratios of axial momentum area to core area and angular-momentum area to core area Core flow reversal is found to be another possible, but secondary, breakdown mechanism A quantitative method is developed for predicting the breakdown point in terms of initial and external aerodynamic conditions, and numerical examples are given which show the effect of external pressure gradients F G M

A75-35173 # Wake vortex decay near the ground J N Hallock (U S Department of Transportation, Transportation Systems Center, Cambridge, Mass) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 8th, Hartford, Conn, June 16-18, 1975, Paper 75-882* 8 p 15 refs

The strength of aircraft wake vortices is being measured for aircraft landing on runway 31R at the John F Kennedy International Airport using monostatic acoustic radars By range gating and Doppler processing the backscattered acoustic energy from a number of sensors, measurements are made of vortex height, strength or circulation, vertical velocity field, translational velocity, and the circulation distribution within the vortex Possible decay mechanisms and correlations with meteorological conditions are presented (Author)

A75-35204 # Integral equations for the calculation of the flow about accelerated slender bodies for M greater, equal, or less than 1 (Integralgleichungen zur Berechnung der Umstromung beschleunigter schlanker Korper fur M greater, equal, or less than 1) J Ballmann (Rheinisch-Westfalische Technische Hochschule, Aachen, West Germany) *(Gesellschaft fur angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Bochum, West Germany, Apr 1-5, 1974) Zeitschrift fur angewandte Mathematik und Mechanik, vol 55, Apr 1975, p T114, T115* In German

A slender body which with a finite translational acceleration passes through a gas that is originally at rest is considered The body produces in the gas a velocity field within a certain area which at sonic speed extends itself into all directions A solution of the problem in three stages is discussed The approach used corresponds to the method used by Prandtl (1936) and Ballmann (1969) G R

A75-35215 # Extension of the parabolic method for the transonic flow I - Steady flow II - Unsteady flow (Erweiterung der parabolischen Methode fur die schallnahe Stromung I - Stationare Stromung II Instationare Stromung) K H Oehmen and I Teipel (Hannover, Technische Hochschule, Hanover, West Germany) *(Gesellschaft fur angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Bochum, West Germany, Apr 1 5, 1974) Zeitschrift fur angewandte Mathematik und Mechanik, vol 55, Apr 1975, p T143 T146* 9 refs In German

The nonlinear initial equation of the theory of first order for transonic flow is given the form of an inhomogeneous parabolic differential equation An approach is shown for obtaining an analytical solution with convergent integrals Results computed for the pressure distribution in the case of two different profiles are presented in graphs The computed values are compared with experimental data Approximate solutions for the unsteady case are derived for the flow at the profile on the basis of linear in homogeneous parabolic differential equations G R

A75-35252 Reliability and maintainability allocation for avionic maintenance optimization D E Brown and W R Krupa (USAF, Systems Command, Wright-Patterson AFB, Ohio) In Automatic support systems for advanced maintainability, Symposium, San Diego, Calif, October 30 November 1, 1974, Conference Record New York, Institute of Electrical and Electronics Engineers, Inc, 1974, p 9-14

A systematic approach for allocating reliability and maintainability factors to weapon system avionics is under development to optimize avionics maintenance This approach will provide a means to establish mission effective maintenance concepts The approach deals with describing functions and allocating reliability and maintainability figures to influence avionics design in terms of the definition of an LRU (Line Replaceable Unit) (Author)

A75-35253 Autotest user needs at a base shop G L Rowe and W Routa (Hughes Aircraft Co, Culver City, Calif) In Automatic support systems for advanced maintainability, Symposium, San Diego, Calif, October 30 November 1, 1974, Conference Record New York, Institute of Electrical and Electronics Engineers, Inc, 1974, p 15-23

The needs of the military user of automatic test equipment at the base shop level of maintenance are discussed Some of the idealized concepts regarding user capabilities, restrictive operating modes, and autotest capabilities are compared with actual experience User organization needs for test equipment maintenance, documentation, and support are also examined V P

A75-35258 # An automated tuneup calibration of jet engine fuel controls W C Haight and H W Hawes (National Bureau of Standards, Washington, D C) In Automatic support systems for advanced maintainability, Symposium, San Diego, Calif, October 30-November 1, 1974, Conference Record New York, Institute of Electrical and Electronics Engineers, Inc, 1974, p 43 54 8 refs Navy supported research

The National Bureau of Standards (NBS) has designed an automated process control system for the calibration of jet engine fuel controls The principal aim of this system is to relieve the test bench operator of the necessity of setting up test conditions and to provide a means of fast and accurate data acquisition When operated under a vendor-supplied real time operating system, the NBS software is designed to afford ease of modification to suit changing test requirements, ease of maintenance, and a degree of transferability between similar applications Attributes contributing to these design goals include a modular program structure, use of a high-level programming language (Fortran) for applications routines, a well-structured file system and utility package, and a mnemonic, test-oriented language developed for coding test procedures

(Author)

A75-35261 **The age of the RPV data bus or the data bus comes of age** L C Pico (Teledyne, Inc, Teledyne Ryan Aeronautical Div, San Diego, Calif) In Automatic support systems for advanced maintainability, Symposium, San Diego Calif, October 30-November 1, 1974, Conference Record New York, Institute of Electrical and Electronics Engineers, Inc, 1974, p 77-83

The use of the airborne onboard processor to operate in a uniquely controlled mode for self validation, and subsequent validation of subsystems that are connected to a multiplexed digital data bus, are described This multiplexed digital data bus concept permits avionics system evaluation without the need for several special test connectors interfacing at the interface unit, typical of the present computer test systems This test concept eliminates the many measurement instruments traditionally used for this purpose The processor instruction and priority schemes are used to individually address each RPV subsystem and conduct evaluations Tests can be selectively structured to permit varying levels of test complexity

(Author)

A75-35264 **Software management and the compiler** L W Wagner (General Dynamics Corp, Fort Worth Tex) In Automatic support systems for advanced maintainability, Symposium, San Diego, Calif, October 30-November 1, 1974, Conference Record New York, Institute of Electrical and Electronics Engineers, Inc, 1974, p 119-122

Management decisions concerning software are discussed, with particular reference to the F 111 ATE (Automatic Test Equipment) program Specifically, it is shown how a decision to develop a compiler saved countless manhours of programming effort The studies which culminated in the proper compiler and language choice are outlined V P

A75-35272 * **Flight test results of an automatic support** *Paper 75-GT 114* 7 p 6 refs Members, $1 00, nonmembers, $3 00 Research supported by the Ministry of Defence (Procurement Executive)

A detailed study of the vibration characteristics of a bladed disk testpiece is reported A description is given of a number of measurements and the corresponding calculations of the many complex vibration modes possessed by a bladed disk when the blades are slightly mistuned Basic theoretical considerations are discussed along with questions concerning the calculation and measurement of mistuned modes, the effects of specific mistune patterns, and the significance of the mode shapes G R

A75-35277 **The B-1 CITS system** H L McCoy and L M Meyers (Rockwell International Corp, Los Angeles, Calif) In Automatic support systems for advanced maintainability, Symposium, San Diego, Calif, October 30 November 1, 1974, Conference Record New York, Institute of Electrical and Electronics Engineers, Inc, 1974, p 254 266

Studies involving the operational use and role of the advanced manned strategic aircraft (AMSA) led to a set of requirements for in-flight and ground testing that could not be met with conventional test equipment With the evolution of AMSA into the B 1 bomber, it became necessary to develop a new onboard test system that would meet the flight crew and to the ground maintenance service The development of the B-1 central integrated test subsystem (CITS) design requirements is described, along with the system design approach and the implementation of the onboard CITS hardware and software V P

A75-35279 **Automatic test equipment for S-3A support** J M Colebank and D E Morrill (Lockheed California Co, Burbank, Calif) In Automatic support systems for advanced maintainability, Symposium, San Diego, Calif, October 30 November 1, 1974, Conference Record New York, Institute of Electrical and Electronics Engineers, Inc, 1974, p 301-310 6 refs

The support of Navy S-3A Viking carrier-based antisubmarine aircraft is based on a structured maintenance plan initiated from aircraft and avionics design The avionics is modularized and is designed for ease of handling and for test by automatic test equipment Onboard diagnostic computer program and built-in test equipment functions provide 95 percent confidence that an item has truly failed before removal to the shop A unified set of general purpose automatic test equipment is used to perform all levels of shop testing to identify the failed component group for repair The avionic design features for maintainability and the test systems which make support of such electronics practical are discussed V P

A75-35283 **A holographic visor helmet-mounted display system** R N Winner (Hughes Aircraft Co, Culver City, Calif) and J H Brindle (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, Ohio) In Conference on Display Devices and Systems, New York, N Y, October 9, 10, 1974, Conference Record New York, Institute of Electrical and Electronics Engineers, Inc, 1975, p 43-52 Contract No F33615-73-C-4110

An engineering evaluation model of a holographic visor helmet mounted display (HVHMD) is described, which represents the first practical use of holographic optics with cathode-ray tube sources for information display A system is described which has the ultimate capability of providing the pilot of an aircraft with a 30 deg field-of-view virtual image of a miniature CRT display source while in head-up or head-down modes of flight Photographs of the HVHMD and of its virtual image, along with analytic and measured performance data are given Conclusions concerning the operation of the first engineering model are made along with specific suggestions and performance predictions for the future (Author)

A75-35284 **Advanced gallium phosphide L E D displays** T F Knibb (Plessey Co, Ltd, Towcester, Northants, England) In Conference on Display Devices and Systems, New York, N Y, October 9, 10, 1974, Conference Record New York, Institute of Electrical and Electronics Engineers, Inc, 1975, p 53-58 Research supported by the Ministry of Defence (Procurement Executive)

The use of 7 segment or dot matrix light-emitting diode (LED) arrays to display the value of some varying parameters in a digital form has, in addition to a number of advantages, the disadvantage of providing little information on the rate of change of the displayed parameter Disturbing display flicker and the possibility of character confusion are other drawbacks of the technique The traditional form of analog displays minimizes these problems, although admittedly at the expense of resolution It was decided at the Royal Aircraft Establishment, therefore, to develop analog instrumentation for future aircraft applications Devices developed by a modular approach are described V P

A75-35290 **Cargo aircraft - A look toward the future** L T Goodmanson and G N Bower (Boeing Commercial Airplane Co, Renton, Wash) *Exxon Air World*, vol 27, no 3, 1975, p 62-66

Development trends and design options are discussed in relation to future cargo aircraft Improvements discussed include the design of airfoil shapes for higher subsonic speeds, the use of composite structures to increase payloads, and the application of computerized tracking and billing systems to reduce overall costs Evolutionary aircraft changes are described, including the design of medium STOL transports and specialized aircraft for narrow tasks as well as the modification of current aircraft to accomodate containerized cargoes Proposals are discussed for a container plane and cost reductions through lower capital, maintenance, and crew costs and higher airplane utilization and load factors It is suggested that energy conservation be accomplished by laminar flow control and the use of airplanes which use liquid hydrogen for fuel   F G M

A75-35298 #   **Influence of protective additions on the anti-wear properties of jet fuels** (Vliianie zashchitnykh prisadok na protivoiznosnye svoistva reaktivnykh topliv) V P Lazarenko, G B Skovorodin, I V Rozhkov, Z A Sablina, and E S Churshukov *Khimiia i Tekhnologiia Topliv i Masel*, no 5, 1975, p 19 21 10 refs In Russian

The influence of some foreign and domestic protective additions on the anti wear properties of T 7 fuel is studied on a friction machine It is shown that there is no direct relationship between the protective and anti wear action of the additions Protective additions containing the carboxyl group were found to be the only effective ones   V P

A75-35299 Δ   **Changes in the properties of hydrogenated fuels during prolonged storing** (Izmenenie svoistv gidrirovannykh topliv pri dlitel'nom khranenii) E P Seregin, B A Englin, M P Alekseeva, G V Kachurina V A Gladkikh, A N Romanov, and A L Ivanov *Khimiia i Tekhnologiia Topliv i Masel*, no 5, 1975, p 27 30 5 refs In Russian

It is shown that storage periods of two or three years lead to a deterioration of the thermal stability of hydrogenated fuels This deterioration may be prevented over a period of five years by adding such anti oxidation (or dispersive) agents as ionola, copolymers of esters of the methacrylic acid, or isopropyl octadecyl amine   V P

A75-35300 #   **Application of thin-layer chromatography for determining the wearing capacity of additives contained in petroleum-based aviation oils** (Primenenie tonkosloinoi khroma tografii dlia opredeleniia srabatyvaemosti prisadok, soderzha shchikhsia v aviatsionnykh neftianykh maslakh) K S Chernova, P A Mikheichev, and M M Vakhmianina (Gosudarstvennyi Nauchno-Issledovatel'skii Institut Geologii Arktiki, USSR) *Khimiia i Tekh nologiia Topliv i Masel*, no 5, 1975, p 56-58 9 refs In Russian

A75-35350 #   **The An-2 aircraft /4th revised and enlarged edition/** (Samolet An-2 /4th revised and enlarged edition/) I V Radchenko, V P Kramchaninov, and V P Dubrinskii Moscow, Izdatel'stvo Transport, 1974 456 p In Russian

The basic design and flight characteristics of the An 2 aircraft and its three modifications are described at length The aircraft is of biplane type, designed for short haul of passengers and cargo Its equipment and instrumentation are described, and the principle difficulties that might be encountered in handling and maintainance of the aircraft are treated Use of the aircraft in agriculture is described   P T H

A75-35403 #   **Response of a light aircraft to a thermal exhaust plume** F W Lipfert, B R McCaffrey (Long Island Lighting Co, Hicksville, N Y), E A Sanlorenzo (General Applied Science Laboratories, Westbury, N Y), P Baronti (Advanced Technology Laboratories, Westbury, N Y), and B W McCormick (Pennsylvania State University, State College, Pa) In Conference on Aerospace and Aeronautical Meteorology, 6th, El Paso, Tex, November 12 15, 1974, Preprints   Boston, Mass, American Meteorological Society, 1974, p 273-280

The present study considers the response of light aircraft to atmospheric disturbances produced by thermal plumes emanating from power plants, particularly stationary gas turbine units The study is based on a theoretical and flight test investigation of a 50 MW gas turbine generating unit located at Shoreham, Long Island, N Y The results were scaled up to provide plume predictions for a 250 MW generating complex The exhaust plume modeling used is based on the work of Hoult, Fay, and Forney (1968), which assumes flow properties that are constant in a direction normal to the axis of the plume, laminar wind and constant entrainment parameters Results of the flight tests indicate that a minimum altitude limit can be safely set at 600 ft above stack exit   S J M

A75-35409 * ;   **High altitude turbulence encountered by the supersonic YF-12A airplane** L J Ehernberger (NASA, Flight Research Center, Edwards, Calif) In Conference on Aerospace and Aeronautical Meteorology, 6th, El Paso, Tex, November 12 15, 1974, Preprints   Boston, Mass, American Mete orological Society, 1974, p 305-312 12 refs

The present work describes the turbulence experienced by the YF 12A airplane on the basis of airplane acceleration data obtained at altitudes above 12 2 km Data presented include the subjective intensities reported by the air crew, the portion of flight distance in turbulence, the variation of turbulence with season, and the thickness and length of turbulence patches as determined along the flight path Compared with that experienced by subsonic jets below 12 2 km, turbulence above 12 2 km was mild, but the crew was more sensitive to gust accelerations during supersonic flight at altitudes above 12 2 km than during subsonic flight at lower altitudes About 6 8% of the distance traveled was in turbulence between 12 2 and 16 8 km, as compared to less than 1% above 18 3 km High altitude turbulence increased by a factor of three from summer to winter Turbulence patches were 0 4 km thick and 10 km long on the average   S J M

A75-35411 * ,   **The influence of wind shear on aerodynamic coefficients** W Frost and E Hutto (Tennessee, University, Tullahoma, Tenn) In Conference on Aerospace and Aeronautical Meteorology, 6th, El Paso, Tex, November 12 15, 1974, Preprints   Boston, Mass, American Meteorological Society, 1974, p 317 324 10 refs Contract No NAS8 27387

The purpose of this study is to investigate the influence of wind shear on the lift, drag, roll and yaw moments of a wing in a horizontal wind gradient at various elevations and roll angles The models of wind shear considered are those proposed by Leurs (1973) for atmospheric flow over horizontally homogeneous and uniform terrain A general series solution for the distribution of lift along the wing span following the method of Houghton and Brock (1970) is employed to compute the loads and moments on the airfoil Results of the computations indicate that wind shear can have a significant effect on the rolling and yawing moments of the wing of an aircraft flying with one wing low in the atmospheric boundary layer These moments are directly influenced by the magnitude of the wind gradient in the neutral atmosphere reflected by the magnitude of the friction velocity The effect of wind shear on lift and drag is negligible Stability of the atmosphere tends to increase the magnitude of the rolling moment while decreasing its variation with elevation   S J M

A75-35413 ;   **Surface wind speed range as a function of time interval and mean wind speed** P Tattelman (USAF, Cambridge Research Laboratories, Bedford, Mass) In Conference on Aerospace and Aeronautical Meteorology 6th, El Paso, Tex November 12 15, 1974, Preprints   Boston, Mass, American Meteorological Society 1974, p 329 334

Nomograms of the 50, 75, 90, and 98 percentile wind speed ranges are obtained for mean speeds between 20 and 100 kts and time intervals between 20 and 600 sec The nomograms indicate that the wind speed range increases with increasing mean speed and

increasing time interval However, the rate of increase diminishes with increasing 5-minute speed At the 98 percentile level, there is even a slight decrease in range (from 80 to 100 kts)   V P

A75-35414 # **Aeronautical requirements and procedure for low-level turbulence and wind shear reporting** M E Nancoo (International Civil Aviation Organization, Montreal Canada) In Conference on Aerospace and Aeronautical Meteorology, 6th, El Paso, Tex , November 12 15, 1974, Preprints (A75 35351 16 47) Boston, Mass , American Meteorological Society, 1974, p 335-338

The nature and characteristics of low level wind shears which are hazardous to aircraft during takeoff and landing are examined The wind shear experienced by aircraft at heights up to 60 m may be caused by vertical variations in the mean flow (vertical shear), by horizontal variations in the mean flow (horizontal shear), by atmospheric turbulence, or by combinations of these factors Specific requirements, criteria, and procedures established by ICAO for reporting vertical wind shear cannot be applied in many cases because of the lack of a reliable system for measuring vertical wind shear The use of tethered balloons and laser Doppler, acoustic Doppler, and radar Doppler systems for this purpose is proposed
                    V P

A75-35418 # **Aircraft turbulence encounters during commercial operations in the vicinity of thunderstorms** P A Barclay In Conference on Aerospace and Aeronautical Meteorology 6th, El Paso, Tex , November 12 15, 1974, Preprints
Boston, Mass , American Meteorological Society, 1974, p 357 360 7 refs

A detailed investigation of turbulence conditions experienced by an aircraft under thunderstorm conditions was conducted at Brisbane Airport in Australia over a two month period in 1972 Aspects of aircraft response to turbulence are discussed along with details concerning the turbulence measurements It was found that for the observations considered the turbulence advisory service and the criterion for assessing severe turbulence from the radar was effective
                    G R

A75-35419 # **A study of self-similarity in boundary layer turbulence and its relevance to aircraft design and operation** R R Brook (Commonwealth of Australia Bureau of Meteorology, Melbourne, Australia) In Conference on Aerospace and Aeronautical Meteorology, 6th, El Paso, Tex , November 12 15, 1974, Preprints   Boston, Mass , American Meteorological Society, 1974, p 361 363 5 refs

An improved method for the description of wind structure is discussed in connection with certain difficulties regarding the representation of single extreme wind gusts by the conventional approach The method considered requires the specification of a design gust as a 'ramp' of given shape, duration, magnitude, and probability of occurrence It is attempted to give the results of applying the 'self similar' model to some unique tower data, to statistically test the effectiveness of the model by a Kolmogorov Smirnov test suggested by Dutton and Deaven (1969)   G R

A75-35420 * # **Wind shear effects on landing touchdown point** J K Luers and J B Reeves (Dayton, University, Dayton, Ohio) In Conference on Aerospace and Aeronautical Meteorology, 6th, El Paso, Tex , November 12 15, 1974, Preprints
                    Boston, Mass , American Meteorological Society, 1974, p 364 369 11 refs Contract No NAS8-26600

In the study reported, an investigation was conducted concerning the shape of wind shear profiles during aircraft landings, taking into account also the values of the meteorological parameters which describe the wind shears Attention is also given to the variation of wind shear effects in the case of different aircraft types The study was conducted for commercial, military, and STOL aircraft A digital landing simulation model was used in the investigations   G R

A75-35422 * # **Wind tunnel tests and computer simulations of buoyant wing-tip vortices** R C Costen, R E Davidson, and G T Rogers (NASA, Langley Research Center, Hampton, Va) In Conference on Aerospace and Aeronautical Meteorology, 6th, El Paso, Tex , November 12 15, 1974, Preprints
Boston, Mass , American Meteorological Society, 1974, p 378 386 12 refs

It is demonstrated that wing tip vortices with buoyant cores can be made in a wind tunnel Wing-tip vortices generated by an aircraft often become buoyant, because of heating effects due to the jet exhaust or in connection with a descending motion in a stable atmosphere A description of wind tunnel studies is given, taking into account the experimental conditions, the transition to turbulence, and the drift of the buoyant vortex A computer simulation of wing tip vortices is also discussed   G R

A75-35423 # **A predictive model of wake vortex transport** M R Brashears (Lockheed Missiles and Space Co , Inc , Huntsville, Ala) and J N Hallock (U S Department of Transportation, Transportation Systems Center, Cambridge, Mass) In Conference on Aerospace and Aeronautical Meteorology, 6th, El Paso, Tex , November 12 15, 1974, Preprints   Boston, Mass , American Meteorological Society, 1974, p 387 392 10 refs

Results are reported for a series of flight tests conducted to verify the predictive model of vortex transport developed by Brashears and Hallock (1974) The tests include measuring atmospheric conditions, forecasting vortex transport, flying various aircraft past ground based and tower mounted equipment, and monitoring vortex tracks Predicted and measured vortex tracks are compared for various aircraft, predicted and measured wind profiles are also compared, and excellent agreement is found between the predictions and measurements Use of this model and meteorological data to forecast vortices at Kennedy Airport is described   F G M

A75-35424 # **The motion of wake vortices in the terminal environment** J N Hallock, W D Wood, and E A Spitzer (U S Department of Transportation, Transportation Systems Center, Cambridge, Mass) In Conference on Aerospace and Aeronautical Meteorology, 6th, El Paso, Tex , November 12 15, 1974, Preprints   Boston, Mass , American Meteorological Society, 1974, p 393 398

The wake vortex problem appearing in connection with the employment of wide body jets, DC-8, and B 707 in the air traffic is to be solved by the development of a Wake Vortex Avoidance System (WVAS) which will be used in the terminal airspace to detect or predict the presence of vortices, to evaluate the threat, and to command a hazard avoidance action Questions of vortex data collection and sensor evaluation are considered, taking into account the design of vortex sensors and the measurement of meteorological conditions A description of the JFK vortex test site is presented Attention is also given to details regarding WVAS development G R

A75-35425 # **Airborne wake vortex detection** J D Fridman (Raytheon Equipment Development Laboratories, Sudbury, Mass) and J N Hallock (U S Department of Transportation, Transportation Systems Center, Cambridge, Mass) In Conference on Aerospace and Aeronautical Meteorology, 6th, El Paso, Tex , November 12 15, 1974, Preprints (A75 35351 16 47) Boston, Mass , American Meteorological Society, 1974, p 399-404 15 refs

Ground based instrumentation cannot provide the pilot with information concerning vortex pairs generated by the preceding aircraft for the time in which the aircraft is in the approach or take-off corridors of the airport For reasons of safety and for a better use of the available air space it would be advantageous if the pilot had the information which could be obtained with the aid of an in flight vortex measurement system Wake vortex signature characteristics are discussed along with details concerning the operation of airborne wake vortex instrumentation systems   G R

A75-35426 # The effects of atmospheric stability, turbulence, and wind shear on aircraft wake behavior I Tombach (AeroVironment, Inc, Pasadena, Calif) In Conference on Aerospace and Aeronautical Meteorology, 6th, El Paso, Tex , November 12 15, 1974, Preprints Boston, Mass , American Meteorological Society 1974, p 405-411 10 refs Research supported by the U S Department of Transportation and U S Air Force

A75-35428 # Preliminary results from pilot aviation weather self-briefing experiments F J Steckbeck (U S Navy, FAA, Systems Research and Development Service, Washington, D C) and H D Milligan (FAA, National Aviation Facilities Experimental Center, Atlantic City, N J) In Conference on Aerospace and Aeronautical Meteorology, 6th, El Paso, Tex , November 12 15, 1974, Preprints Boston, Mass , American Meteorological Society, 1974, p 418 425

Results are reported for field experiments conducted to evaluate the efficacy of the Pilot Self Briefing Terminals which have been proposed to provide weather information to general aviation pilots The project objectives and experimental plan are described, and the data flow for the live data field experiments is illustrated The primary briefing format is discussed in detail, and data samples are presented for the alphanumeric and graphic modes The major problem encountered by pilots in the field experiments is shown to be the massive amount of data that had to be evaluated since the readouts provided regional weather forecasts It is recommended that a grid form be used for the weather data in order to reduce the amount of data and the terminal occupancy time F G M

A75-35434 # Lidar techniques for measuring slant visibility J R Lifsitz (U S Department of Transportation, Transportation Systems Center, Cambridge, Mass) In Conference on Aerospace and Aeronautical Meteorology, 6th, El Paso, Tex , November 12 15, 1974, Preprints Boston, Mass , American Meteorological Society, 1974, p 452 457 6 refs

Optical radar appears to be unique in its potential to provide visibility information about the slant paths critical to the pilot during low-visibility landing operations An investigation was conducted to assess the feasibility of the optical radar technique Two pulsed optical radar devices were built and successfully tested The results obtained confirm other recent studies which show that the technique can be applied to determine the atmospheric extinction coefficient, and hence the visibility, over an extended range of space G R

A75-35449 # The economic advantages of low and high temperature anti corrosion coatings on jet engine parts - A case history B Helan (Rolls Royce /1971/, Ltd , Engine Div , Derby, England) In Economics of corrosion control, Autumn Review Course, York, England, November 1-3, 1974, Proceedings Series 3, Number 2 London, Institution of Metallurgists, 1974, p 118-129, Discussion, p 130

Jet engine compressor and turbine parts operating in hostile environments have sometimes required replacing after short service lives due to the effects of corrosion These situations, if uncontrolled, could lead to penalizing financial consequences and seriously jeopardize airline operations Case histories of the major corrosion problems experienced on Rolls Royce engine parts and the economic effects will be described together with the action taken to eliminate the incidents The use of high temperature coatings and other anti-corrosion measures will be discussed (Author)

A75 35450 # Study of the interaction and three-dimensional separation effects of a boundary layer in a supersonic laminar regime (Etude des effets d'interaction et de decollement tridimensionnel de la couche limite en régime laminaire supersonique) P Srinivasan Poitiers, Universite, Docteur es Sciences Thesis, 1973 147 p 85 refs In French Direction des Recherches et Moyens d'Essais Contracts No 122/4, No 70/145

The present paper experimentally and theoretically investigates the phenomena of viscous interaction and of three dimensional separation of a laminar boundary layer in supersonic flow For the experimental study, flat delta wings furnished with flaps at their trailing edges were used The theoretical approach is based on boundary layer equations in interaction regime with the external flow A longitudinal velocity profile and an enthalpy distribution are deduced from exact similarity solutions of the laminar boundary layer equations In order to obtain a profile of transverse velocity, a polynomial representation associated with the longitudinal profile is used The theoretical results are compared to the experimental findings for pressure, heat transfer, and parietal current lines S J M

A75-35519 # Engineering titanium alloys (Konstruktsionnye titanovye splavy) S G Glazunov and V N Moiseev Moscow, Izdatel'stvo Metallurgiia, 1974 368 p 157 refs In Russian

The present work is concerned with the structure, physico mechanical properties, heat treatment, technological properties, and application fields of titanium alloys The topics discussed include phase transformations of titanium alloys, techniques of increasing their strength, description of the mechanical properties of medium and high-strength titanium alloys, annealing and interaction between titanium and gases during heating in air, and weldability, mechanical working, and chemical processing of titanium alloys Also discussed are such fields of application as mechanical engineering and chemical and aircraft industries S D

A75-35521 # Matching of aircraft and engine characteristics (Soglasovanie kharakteristik samoleta i dvigatelia) O K Iugov and O D Selivanov Moscow, Izdatel'stvo Mashinostroenie, 1975 204 p 62 refs In Russian

The book deals with the basic principles and methods of choosing the parameters, dimensions, and operating conditions of an aircraft and its power plant at early design stages Simplified techniques are described concerning the preliminary design of the aerodynamic and weight characteristics of an airframe, the gas-dynamic, weight, and aerodynamic characteristics of an aircraft engine, and the performance characteristics of an aircraft with allowance for possible constraints Particular attention is given to such optimization methods of matching aircraft and engine characteristics as the method of Lagrange multipliers, the method of steepest descents, the relaxation method, and the scanning method S D

A75-35706 Problem of supersonic flow past a slender pointed body with tail E M Surkova (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) (Moskovskii Universitet, Vestnik, Seriia I - Matematika, Mekhanika, vol 29, Nov Dec 1974, p 66 73) Moscow University Mechanics Bulletin, vol 29, no 5-6, 1974, p 43-49 7 refs Translation

A75-35765 The drag and oscillating transverse force on vibrating cylinders due to steady fluid flow D W Sallet (Maryland, University, College Park, Md) Ingenieur-Archiv, vol 44, no 2, 1975, p 113 122 21 refs

When a cylinder is exposed to cross flow, oscillating transverse forces act on the cylinder in addition to the nearly steady drag forces If the cylinder is elastic or elastically supported, the oscillating transverse or lift forces will cause flow induced vibrations of the cylinder These vibrations, in turn, will cause significant changes in the drag forces as well as in the lift forces itself which initially caused the flow induced vibrations This article develops a theory with which the drag and lift forces acting on vibrating cylinders can be predicted The theory is based upon a simplified, hypothetical, two-dimensional wake model The stipulated assumptions restrict the validity of the theory to small amplitude vibrations in the frequency range at which 'lock in' occurs, i e at which the vibration prescribes the vortex shedding frequency (Author)

A75-35796 #   Loran-C compared with other navigation aids in meeting future Canadian needs R M Eaton (Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada) *Canadian Aeronautics and Space Journal,* vol 21, Apr 1975, p 133-137 7 refs

A preliminary review of the Canadian requirements for navigation aids (navaids) suggests that 200 m repeatability and 1,000 m geographic accuracy will be needed The most immediate urgency appears to be on the Atlantic Continental Shelf and for exploration in the Arctic A thorough and comprehensive study is needed to establish user's requirements over the next 15-20 years, and then to determine the most effective navaid combination, carrying out technical tests as necessary Loran C is one candidate to fill the Canadian requirement, but, as with any other candidate, a number of technical questions need to be answered Canada has perhaps a year to decide how best to interface with the imminent expansion of Loran-C by the United States Coast Guard on the Pacific and Atlantic coasts and over the Great Lakes   (Author)

A75-35806 #   Comparison of flight and wind tunnel tests of an executive airplane (Comparison des essais en soufflerie et des essais en vol pour un avion exécutive) J Maestrati (Avions Marcel Dassault Breguet Aviation, Merignac, Gironde, France) *Association Aeronautique et Astronautique de France, Colloque d'Aerodynamique Appliquee, 11th, Universite de Bordeaux I, Talence, Gironde, France, Nov 6 8, 1974, Paper* 22 p In French

An experimental study is analyzed in order to determine the degree of correspondence between wind tunnel and inflight testing results for an executive airplane It is shown that at least in the linear portions of the characteristic curves examined, there is a close agreement between the two modes of testing Two types of comparison were undertaken a direct or point comparison, and an indirect or global comparison Results are presented for the longitudinal and latitudinal axes of the aircraft Some limitations on the accuracy of the wind tunnel simulations are also pointed out
S J M

A75-35808 #   Interaction of jets of GE CF6 50 reactors with the wing cellules of the airbus during cruise - Wind tunnel simulation (Interaction des jets des réacteurs GE CF6-50 sur la cellule de l'airbus en croisiere - Simulation en soufflerie) M Saiz (Societe Nationale Industrielle Aerospatiale, Toulouse, France) *Association Aéronautique et Astronautique de France, Colloque d'Aerodynamique Appliquée, 11th, Universite de Bordeaux I, Talence, Gironde, France, Nov 6-8, 1974, Paper* 40 p 10 refs In French

The present work consists of three parts The first section defines the explicit balance between the components of drag and of thrust from the cellule propulsive ensemble, while evaluating the nature of mutual interactions The second part reviews the experimental technique used to determine these interactions, simulations were performed with a mock-up mounted on the wall of a transonic wind tunnel and equipped with a motorized nacelle The third section of the paper presents an application of the pressure measurements made during the tests and confirms the validity of the method of investigation used, as well as determining the value of the interaction between engine jets in cruise flight   S J M

A75-35810 #   Some problems posed by the aerodynamics of the dirigible balloon (Quelques problèmes poses par l'aérodynamique du ballon dirigeable) L Cabot (ONERA, Châtillon-sous Bagneux, Hauts-de-Seine, France) *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 11th, Université de Bordeaux I, Talence, Gironde, France, Nov 6-8, 1974, Paper* 18 p In French Research supported by the Centre National d'Etudes Spatiales

Following a brief survey of various aerodynamic problems raised by the aerodynamics of the airship, several results are presented concerning (1) a dirigible of classical configuration (the 1931 American Akron) and (2) a proposed lens shaped omnidirectional vehicle (the French Pegasus) General areas discussed include the distribution of loads, resistance to forward motion, propulsion, stability and control, and drag-conscious rudder design Problems of

stability and drag often occur and are difficult to solve, since the flow often separates at the rear of the craft   S J M

A75-35811 #   Study on the establishment of flow in a wind tunnel functioning by induction (Etude de l'etablissement de l'ecoulement dans une soufflerie fonctionnant par induction) A Mignosi and C Quemard (ONERA, Centre d'Etudes et de Recherches, Toulouse, France) *Association Aeronautique et Astronautique de France, Colloque d'Aérodynamique Appliquee, 11th, Université de Bordeaux I, Talence, Gironde, France, Nov 6-8, 1974, Paper* 24 p In French

An investigation into the problem of establishing a flow regime in a subsonic transonic wind tunnel functioning by induction is presented It entails, on the theoretical plane, solving equations in the conservation of flow and energy, written for a nonstationary flow On the experimental level, a series of systematic experiments carried out on a small-scale pilot plant is described An examination of the results obtained shows that it is possible to predict and control the time to flow establishment and the fluctuations in flow parameters   S J M

A75 35813 #   Calculations of three-dimensional flows in a linearized supersonic regime (Calculs d'ecoulements tridimensionnels en supersonique linearisé) P Schein (Avions Marcel Dassault-Breguet Aviation, Paris, France) *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 11th, Universite de Bordeaux I, Talence, Gironde, France, Nov 6-8, 1974, Paper* 49 p 15 refs In French

A relatively rapid means of calculating supersonic flow parameters based on the finite difference method and containing several simplifying hypotheses is presented The specific problem treated concerns engine-wing cell integration at the level of distortions in air entry Emphasis is on the substantial differences between subsonic and supersonic flow properties, and on the need for modifying subsonic numerical treatments before applying them to supersonic regimes A comparison with some experimental results on military airplanes proves the accuracy of the method   S J M

A75-35814 #   Aerodynamics of rotors - Wake equilibration (Aerodynamique des rotors mise en equilibre du sillage) B Courjaret (Societe Nationale Industrielle Aerospatiale, Châtillon-sous Bagneux, Hauts de-Seine, France) *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 11th, Université de Bordeaux I, Talence, Gironde, France, Nov 6-8, 1974, Paper* 25 p In French Research supported by the Direction des Recherches et Moyens d'Essais

A method is proposed which permits the resolution of integro differential relations defining, on the one hand, the form of the wake of a rotor in axial translational motion, and on the other hand, the circulation distribution connected with the length of the rotor blades The advantages due to the turbulent rotor wake becoming stable are significant, as the specific load on the rotor increases, i e, when a marked contraction of the turbulent layer occurs   S J M

A75-35815 #   Aerodynamics of lifting and propulsive systems in a periodically functioning regime -'Optimization of their performance (Aérodynamique des systèmes portants et propulsifs en régime de fonctionnement periodique   Optimisation de leurs performances) G Coulmy, T S Luu, and L Malavard *Association Aeronautique et Astronautique de France, Colloque d'Aero-dynamique Appliquée, 11th, Université de Bordeaux I, Talence, Gironde, France, Nov 6-8, 1974, Paper* 74 p 16 refs In French

The present memoir generalizes certain concepts in the turbulent theory of airfoils, with emphasis on the nonstationary aspect of the flows involved A unified theory of lifting and propulsive systems is derived based on the classical hypothesis of small perturbations It is shown that the condition of optimal functioning, which corresponds to a minimum energy loss, amounts to a simple condition of the Neumann type for the velocity potential This last finding holds for both stationary and nonstationary flight It is then

possible to determine the distribution of circulation in the layer
forming the turbulent wake of the airfoil, and thus the distribution
of circulation on the scale of each active system element   S J M

A75-35819 #   **Two-dimensional transonic calculations with
boundary layers (Calculs bidimensionnels transsoniques avec couche
limite)** J Bousquet (Societe Nationale Industrielle Aerospatiale,
Paris, France) *Association Aéronautique et Astronautique de
France, Colloque d'Aérodynamique Appliquée, 11th, Université de
Bordeaux I, Talence, Gironde, France, Nov 6-8, 1974, Paper* 32 p
11 refs In French
    The method of calculating aerodynamic parameters in a perfect
fluid derived by Garabedian-Korn is examined in order to determine
its limits of validity, particularly in the presence of a shock wave A
theoretical discussion ascertains the extent of the influence of
displacement of the boundary layer on the accuracy of the method
It is shown that the calculation technique can fit very advantageously
into a modern scheme of profile determination   S J M

A75-35827   Small antennas H A Wheeler (Hazeltine
Corp , Greenlawn, N Y) *IEEE Transactions on Antennas and
Propagation,* vol AP 23, July 1975, p 462 469 12 refs Research
supported by the Bell Telephone Laboratories, U S Air Force, and
U S Navy
    A small antenna is one whose size is a small fraction of the
wavelength It is a capacitor or inductor, and it is tuned to resonance
by a reactor of opposite kind Its bandwidth of impedance matching
is subject to a fundamental limitation measured by its 'radiation
power factor' which is proportional to its 'effective volume' These
principles are reviewed in the light of a quarter century of ex-
perience They are related to various practical configurations,
including flush radiators for mounting on aircraft Among the
examples, one extreme is a small one-turn loop of wide strip, tuned
by an integral capacitor The opposite extreme is the largest antenna
in the world, which is a 'small antenna' in terms of its operating
wavelength In each of these extremes, the radiation power factor is
much less than one percent   (Author)

A75-35869 #   **Wind tunnel test of a flutter suppressor on a
straight wing (Essai en soufflerie d'un suppresseur de flottement sur
une aile droite)** R Destuynder (ONERA, Châtillon sous-Bagneux,
Hauts-de-Seine, France) *(NATO, AGARD, Réunion sur la Sup-
pression du Flottement et la Réduction des Charges Structurales,
Brussels, Belgium, Apr 13-18, 1975) ONERA, TP* no 1975 31,
1975, 4 p In French
    An experimental wind tunnel study of aileron control of the
fundamental bending torsion flutter of a wing caused by a load hung
under it is presented Use of an aerodynamically uncoupled control
surface simplified the transfer function of the servo-system It is
concluded that the control thus obtained is not optimal, but that it
does not require a precise knowledge of aerodynamic forces and wing
dynamic characteristics, and that it provides an increased damping
ratio over the entire velocity range   S J M

STAR ENTRIES

N75-23475 Tecimar S A R L Paris (France)
STUDIES AND RESEARCH ON MARINE HULLS WORKING WITH NATURAL GROUND EFFECT Final Report
L P Untersteller and M Ebersolt Apr 1974 79 p refs In FRENCH ENGLISH summary
(Contract DGRST-69-01-723)
Avail Issuing Activity
Methods for computing thick and thin airfoils of infinite aspect ratio are presented The solutions are used to determine the characteristics of a finite aspect ratio airfoil Such an airfoil was tested for several flight conditions in an aerodynamical wind tunnel Test results were applied to the design a hovercraft for marine use   ESRO

N75-23476*# National Aeronautics and Space Administration Lyndon B Johnson Space Center Houston Tex
SURFACE FINISHING Patent Application
Jack A Kinzler James T Heffernan Leroy G Fehrenkamp and William S Lee inventors (to NASA) Filed 16 Apr 1975 26 p
(NASA-Case-MSC-12631-1 US-Patent-Appl-SN-568541) Avail NTIS HC $3 75 CSCL 01C
An airfoil configuration and manufacturing process was designed to reduce or eliminate air turbulence created by surface irregularities in metal due to rivets wrinkles and butt-joints The metal surface of an airfoil was cleaned then coated with a thin layer of a fluid adhesive over which a sheet of thin plastic film was stretched Tension was applied to the film and the resultant surface was squeezed to cause the adhesive to conform to the irregularities remove any bubbles and smooth out any wrinkles in the film The adhesive was then allowed to set The resulting surface is smooth and relatively free of the normal irregularities present in the standard metal airfoil particularly for low speed aircraft   NASA

N75-23477*# Boston Univ Mass Dept of Aerospace Engineering
A FINITE-ELEMENT METHOD FOR LIFTING SURFACES IN STEADY INCOMPRESSIBLE SUBSONIC FLOW
Luigi Morino and Emil Suciu Dec 1974 38 p refs
(Grant NGR-22-004-030)
(NASA-CR-142811 TR-74-05) Avail NTIS HC $3 75 CSCL 01C
The problem of potential steady subsonic flow for lifting surfaces is considered This problem requires the solution of an integral equation relating the value of the potential discontinuity on the lifting surface and its wake to the values of the normal derivative of the potential which are known from the boundary conditions The lifting surface is divided into small (quadrilateral hyperboloidal) surface elements which are described in terms of the Cartesian components of the four corner points The values of the potential discontinuity and the normal derivative of the potential are assumed to be constant within each element and equal to their values at the centroids of the elements This yields a set of linear algebraic equations Numerical results are in good agreement with existing ones   Author

N75-23478*# Boston Univ, Mass Dept of Aerospace Engineering
SUBSONIC AND SUPERSONIC INDICIAL AERODYNAMICS AND AERODYNAMIC TRANSFER FUNCTION FOR COMPLEX CONFIGURATIONS
Luigi Morino Sep 1974 33 p refs
(Grant NGR-22-004-030)

(NASA-CR-142818 TN-74-01) Avail NTIS HC $3 75 CSCL 20D
A general theory for indicial-potential-compressible aerodynamics around complex configurations is presented The motion is assumed to consist of constant subsonic or supersonic speed (steady state) and small perturbations around the steady state Using the finite-element method to discretize the space problem a set of differential-difference equations in time relating the potential to its normal derivative on the surface of the body was obtained The aerodynamics transfer function was derived by using standard method of operational calculus   Author

N75-23479*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
EXPERIMENTAL STUDY OF THE EFFECT ON SPAN LOADING ON AIRCRAFT WAKES
Victor R Corsiglia Vernon J Rossow and Donald L Ciffone May 1975 11 p refs Presented at the AIAA 8th Fluid and Plasma Dyn Conf Hartford 16-18 Jun 1975
(NASA-TM-X-62431 A-6064) Avail NTIS HC $3 25 CSCL 20D
Measurements were made in the NASA-Ames 40- by 80-foot wind tunnel of the rolling moment induced on a following model in the wake 13 6 spans behind a subsonic transport model for a variety of trailing edge flap settings of the generator It was found that the rolling moment on the following model was reduced substantially compared to the conventional landing configuration by reshaping the span loading on the generating model to approximate a span loading found in earlier studies which resulted in reduced wake velocities This was accomplished by retracting the outboard trailing edge flaps It was concluded based on flow visualization conducted in the wind tunnel as well as in a water tow facility that this flap arrangement redistributes the vorticity shed by the wing along the span to form three vortex pairs that interact to disperse the wake   Author

N75-23480*# Kanner (Leo) Associates Redwood City Calif
GROUND EFFECTS FOR JET LIFT VTOL
R Behnert R Roekmojoto and K-H Kleppe Washington NASA May 1975 254 p refs Transl into ENGLISH from ZTL-Zukunfts-Technik-Luft FAG 4 Jahresabschlussbericht 1971 VFW-Fokker (West Germany) 8 Apr 1971
(Contract NASw-2481)
(NASA-TT-F-16359) Avail NTIS HC $8 50 CSCL 01A
The conversion hypothesis proposed by VFW-Fokker is shown to be valid for the fountain of a four jet group The effects of temperature upon the expansion and the behavior of the mixture regions of compressible gas flows is isolated The position of the ground stagnation point for multi-jet groups is determined with the assumption of two dimensional behavior of the flow at the ground region Momentum variations achieved through increases in nozzle size of momentum yield varying ground stagnation points The total pressure at the region of origin of a fountain is shown to be independent from the distance from the ground of the generating nozzles The fountain direction is approximated from the momentum ratio at the ground stagnation point   Author

N75-23481*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
VELOCITY AND ROLLING-MOMENT MEASUREMENTS IN THE WAKE OF A SWEPT-WING MODEL IN THE 40 BY 80 FOOT WIND TUNNEL
Vernon J Rossow Victor R Corsiglia Richard G Schwind (Nielson Eng and Res Inc Mountain View Calif) Juanita K D Frick (Army Air Mobility R and D Lab Moffett Field Calif) and Opal J Lemmer (Army Air Mobility R and D Lab Moffett Field Calif) Apr 1975 36 p refs
(NASA-TM-X-62414 A-5918) Avail NTIS HC $3 75 CSCL 01A
Measurements were made in the wake of a swept wing model to study the structure of lift generated vortex wakes shed by conventional span loadings and by several span loadings designed to reduce wake velocities Variations in the span loading on the swept wing generator were obtained by deflecting seven flap segments on each side by amounts determined by vortex

lattice theory to approximate the desired span loadings The resulting wakes were probed with a three component hot wire probe to measure velocity and with a wing to measure the rolling moment that would be induced on a following aircraft The experimental techniques are described herein and the measured velocity and rolling moments are presented along with some comparisons with the applicable theories   Author

N75-23482*# Nielsen Engineering and Research Inc Mountain View Calif
ANALYSIS OF WAKE VORTEX FLIGHT TEST DATA BEHIND A T-33 AIRCRAFT
Gary D Kuhn and Robert A Jacobsen Apr 1975 80 p refs
(Contract NAS2-6973)
(NASA-CR-137669 NEAR-TR-84) Avail NTIS HC $4 75 CSCL 20D
    Measurements of the vortex system behind a T-33 aircraft were obtained by a Learjet equipped with a boom carrying a three-wire hot-wire anemometry probe and other instrumentation Analysis of the measurements using a computerized geometric method indicated the vortices had a core radius of approximately 0 11 meter with a maximum velocity of 25 meters per second The hot-wire anemometer was found to be a practical and sensitive instrument for determining in-flight vortex velocities No longitudinal instabilities buoyant effects or vortex breakdowns were evident in the data which included vortex wake cross sections from 0 24 to 5 22 kilometers behind the T-33   Author

N75-23483*# Nielsen Engineering and Research Inc Mountain View Calif
CALCULATION OF STATIC LONGITUDINAL AERODYNAM-IC CHARACTERISTICS OF STOL AIRCRAFT WITH UPPER SURFACE BLOWN FLAPS
M R Mendenhall S C Perkin Jr F K Goodwin and S B Spangler Apr 1975 63 p refs
(Contract NAS2-8268)
(NASA-CR-137646 NEAR-TR-83) Avail NTIS HC $4 25 CSCL 20D
    An existing prediction method developed for EBF aircraft configurations was applied to USB configurations to determine its potential utility in predicting USB aerodynamic characteristics An existing wing-flap vortex-lattice computer program was modified to handle multiple spanwise flap segments at different flap angles A potential flow turbofan wake model developed for circular cross-section jets was used to model a rectangular cross-section jet wake by placing a number of circular jets side by side The calculation procedure was evaluated by comparison of measured and predicted aerodynamic characteristics on a variety of USB configurations The method is limited to the case where the flow and geometry of the configuration are symmetric about a vertical plane containing the wing root chord Comparison of predicted and measured lift and pitching moment coefficients were made on swept wings with one and two engines per wing panel various flap deflection angles and a range of thrust coefficients The results indicate satisfactory prediction of lift for flap deflections up to 55 and thrust coefficients less than 2 The applicability of the prediction procedure to USB configurations is evaluated, and specific recommendations for improvements are discussed   Author

N75-23484*# Wichita State Univ Kans
EFFECTIVENESS OF SPOILERS ON THE GA(W)-1 AIRFOIL WITH A HIGH PERFORMANCE FOWLER FLAP
W H Wentz, Jr Washington NASA May 1975 70 p refs
(Grant NGR-17-002-072)
(NASA-CR-2538) Avail NTIS HC $4 25 CSCL 01A
    Two-dimensional wind-tunnel tests were conducted to determine effectiveness of spoilers applied to the GA(W)-1 airfoil Tests of several spoiler configurations show adequate control effectiveness with flap nested It is found that providing a vent path allowing lower surface air to escape to the upper surface as the spoiler opens alleviates control reversal and hysteresis tendencies Spoiler cross-sectional shape variations generally have a modest influence on control characteristics A series of comparative tests of vortex generators applied to the (GA-W)-1 airfoil show that triangular planform vortex generators are superior to square planform vortex generators of the same span   Author

N75-23485# Advisory Group for Aerospace Research and Development, Paris (France)
AIRFRAME/PROPULSION INTERFERENCE
Mar 1975 419 p refs In ENGLISH, partly in FRENCH Presented at the Fluid Dyn Panel Symp Rome 3-6 Sep 1974
(AGARD-CP-150) Avail NTIS HC $10 50 CSCL 01A
    The proceedings are reported of the Fluid Dynamics Panel Symposium held in Rome Research on airframe/propulsion interference, and the design of combat and transport aircraft were discussed

N75-23486 Office National d Etudes et de Recherches Aerospatiales Paris (France)
INTERACTION PROBLEMS BETWEEN AIR INTAKES AND AIRCRAFT [PROBLEMES D'INTERACTIONS ENTRE LA PRISE D'AIR ET L'AVION]
Jacky Leynaert In AGARD Airframe/Propulsion Interference Mar 1975 11 p refs In FRENCH
    The definition of the interaction terms between the air intake and the airframe and the theoretical and experimental tools used to study the problem for subsonic or supersonic aircraft are presented Some examples of the influence of a nonuniform upstream flow on the internal flow characteristics of supersonic intakes are given and some means of adjusting the inlet to a nonuniform flow mainly for flight with incidence or yaw, are analyzed   Author

N75-23487 Northrop Corp Hawthorne Calif
A CRITERION FOR PREDICTION OF AIRFRAME INTEGRATION EFFECTS ON INLET STABILITY WITH APPLICATION TO ADVANCED FIGHTER AIRCRAFT
Gordon R Hall In AGARD Airframe/Propulsion Interference Mar 1975 15 p refs
    A simple criterion for the prediction of the effects of aircraft external flow field on installed inlet stability is presented Wind tunnel data obtained from model tests of an advanced fighter aircraft are used to provide a base for discussion of installed inlet instability and to demonstrate the instability criterion Specifically two sources of supersonic inlet instability are identified, the instability mechanism is discussed and an instability criterion is defined and application of the criterion is demonstrated The sources of instability include ingestion of separated fuselage boundary layer at high aircraft attitude and ingestion of a vortex generated by a wing leading edge extension at negative attitude A common stability criterion accounting for the effect of freestream Mach number, aircraft attitude, and inlet mass flow ratio is postulated and confirmed by available data This same criterion is discussed in relation to observed cases of subsonic inlet instability and inlet instability resulting from slipstream ingestion Application of the criterion to evaluate the effects of configuration changes on inlet stability boundaries is demonstrated   Author

N75-23488 Aircraft Research Association Ltd Bedford (England)
THE MEASUREMENT OF THE TRANSONIC SPILLAGE DRAG OF A SUPERSONIC INTAKE
S A M Thornley and E C Carter In AGARD Airframe/Propulsion Interference Mar 1975 13 p refs
    The technique is described in current use at the Aircraft Research Association for the measurement of the transonic spillage drag of a two dimensional ramp intake The method requires the calibration of the intake duct system for both mass flow and exit momentum The technique is equally applicable to supersonic testing The achieved repeatability of the measurements allows intake configuration differentiation to + or - 1% in aircraft drag for a typical supersonic fighter aircraft at high subsonic speed Theoretically based calculations show satisfactory agreement with the measurements both for a range of intake mass flow and for intake ramp angle changes The technique is economical and suitable for routine testing General comments on the merits of methods available for the measurement of spillage drag using the balance mounted and whole model technique

are presented together with recommendations for further technique development   Author

N75-23489 Grumman Aerospace Corp , Bethpage N Y
AN EXPERIMENTAL INVESTIGATION OF THE COMPONENT DRAG COMPOSITION OF A TWO-DIMENSIONAL INLET AT TRANSONIC AND SUPERSONIC SPEEDS
Clifton J Callahan In AGARD Airframe/Propulsion Interference Mar 1975 16 p refs
An experimental study was performed to establish the separate drag force contributions of the principal components of a rectangular two-dimensional, external compression type, supersonic air induction inlet system Concurrently inlet system performance was measured in terms of engine face total pressure recovery and spacial flow distortion and the possibility for tradeoff between inlet system drag and performance was explored A scale model of the forebody, including air inlet and duct systems of an advanced, twin engine strike aircraft was employed for the study The wind tunnel model arrangement utilized a dual-balance technique to measure forebody and the inlet forces separately The effects on the air induction system and vehicle forebody due to inlet component changes and varying propulsion air flow requirement were identified The major inlet variables in the investigation included cowling lip and sidewall geometries boundary layer bleed and air bypass exhaust configuration and compression surface deflection schedule The wind tunnel testing was conducted in closed circuit continuous flow test facilities over a full range of supersonic and transonic speeds and representative ranges of vehicle angles of attack and sideslip Three significant aspects of the program are addressed inlet and vehicle configuration integration wind tunnel model arrangement for force data measurement and measured drag and performance results These data can be broadly divided according to cowling side wall and bleed/bypass effects in order to display major trends in drag and performance for the investigated transonic and supersonic speed regimes   Author

N75-23490 National Aerospace Lab Amsterdam (Netherlands)
JET INTERFERENCE OF A PODDED ENGINE INSTALLATION AT CRUISE CONDITIONS
B Munniksma and F Jaarsma In AGARD Airframe/Propulsion Interference Mar 1975 16 p refs

The results of an experimental wind tunnel test program on the wing-pylon-bypass engine combination of the Airbus A 300 B airplane are presented Only aerodynamic interference due to the engine jet was considered For determining the interference drag due to the engine jet as well as to have the possibility to extrapolate the test results from model reference conditions to full scale a test scheme was developed To prove the validity of the assumptions of this scheme several intermediate steps were made As the engine jet-airframe interference is mutual also effects of the external flow on the internal engine nozzle flow causing engine shifting has to be considered In order to estimate the magnitude of this influence of the external flow field a two-dimensional model of the fan nozzle has been tested using an optical technique From these tests the specific features of the fan nozzle flow field ranging from subcritical via supercritical to choked conditions are described   Author

N75-23491 Avions Marcel Dassault-Breguet Aviation Saint-Cloud (France)
EFFECT OF EXTERNAL CONDITIONS ON THE FUNCTIONING OF A DUAL FLOW SUPERSONIC NOZZLE [EFFET DES CONDITIONS EXTERIEURES SUR LE FONCTIONNEMENT D'UNE TUYERE SUPERSONIQUE DOUBLE-FLUX]
Guy DeRichemont and J Delery (Office Natl d Etudes et de Rech Aerospatiales, Paris) In AGARD Airframe/Propulsion Interference Mar 1975 14 p refs In FRENCH ENGLISH summary
The design of versatile military aircraft implies a very careful study of the propulsion system taking into account interferences with the external flow A possible solution to this difficult problem of adaptation is that of a dual flow system consisting of two nozzles with variable sections Flow regimes where the primary jet impiges on the secondary nozzle are considered The evolution

is analyzed of the phenomena when the external pressure and the distance between primary injector exhaust plane and the nozzle exit are varied This experimental study shows the influence of the external conditions upon the functioning of the nozzle Theoretical methods are given which allow a reasonable prediction of nozzle performance under such conditions   Author

N75-23492 LTV Aerospace Corp Dallas Tex   Vought Systems Div
SUBSONIC BASE AND BOATTAIL DRAG, AN ANALYTICAL APPROACH
J K Quermann In AGARD Airframe/Propulsion Interference Mar 1975 12 p refs
Methods of subsonic potential flow were applied to the calculation of base and boattail drag For configurations with a base the Korst method was extended to subsonic flow by incorporating a standard family of free streamline shapes and a semi-empirical scheme for selecting the total pressure on the dividing streamline The potential flow around the shape defined by the body free streamline and jet establishes the base and boattail pressures Significant parts of the drag associated with the base actually appear on the boattail In the absence of a base the effect of the jet shape is felt by the boattail With an underexpanded supersonic jet a portion of the thrust which would otherwise be lost in external expansion is recovered on the boattail The fraction recovered drops rapidly with increasing jet pressure ratio Results are compared with flight and wind tunnel tests on the Vought A-7 Airplane   Author

N75-23493 Office National d Etudes et de Recherches Aerospatiales Paris (France)
THEORY OF MIXING FLOW OF A PERFECT FLUID AROUND AN AFTERBODY AND A PROPULSIVE JET [COUPLAGE ENTRE L'ECOULEMENT AUTOUR D'UN ARRIERE-CORPS ET LE JET PROPULSIF EN THEORIE DE FLUIDE PARFAIT]
Roland Maria Sube Jean-Jacques Chattot, and Georges Gillon In AGARD Airframe/Propulsion Interference Mar 1975 12 p refs In FRENCH ENGLISH summary

The interference effects between external and internal flows are examined in the framework of the inviscid flow theory These phenomena are connected mainly with flows around afterbodies Subcritical axisymmetrical interacting flows are studied The computation of both internal and external flows is carried out using a finite element method The results make it possible to determine the shape of the jet using a pseudo-hodographic method with an iterative procedure The interference effects of a supersonic internal flow with subsonic or transonic external flows are considered The supersonic internal jet is computed using the method of characteristics The coupling conditions between the internal and the external flows are taken into account using an iterative procedure in a way similar to that proposed by Young but extended to compressible external flows A comparison with existing experimental results is presented
                                                                    Author

N75-23494 New York Univ N Y   Aerospace Lab
LOW SPEED INJECTION EFFECTS ON THE AERODYNAMIC PERFORMANCE AT TRANSONIC SPEED
Renzo Piva In AGARD Airframe/Propulsion Interference Mar 1975 10 p refs Prepared jointly with Rome Univ

The problem concerning the possible reduction of the transonic drag for a high speed airplane was studied to enhance the aerodynamic performance at low altitudes when the drag must be minimized Attention was focused on decreasing the drag forces on the aft portion of the vehicle An experimental investigation was conducted to determine the effect on afterbody drag of the injection of a small amount of air spilled from the propulsive system having low stagnation pressure in the rear of the model The purpose of this injection was to avoid overexpansion of the flow and to increase the average pressure on the aft section The main problem to be investigated is where the injection is most effective and the amount of air required to

avoid downstream reattachment Some results are presented It was found that the required amount of air is relatively low, because of the high sensitivity of the interaction region to any small change in the flow regime   Author

N75-23495 Societe Nationale d Etude et de Construction de Moteurs d Aviation Melun (France)
RESEARCH ABOUT EFFECTS OF EXTERNAL FLOW AND AIRCRAFT INSTALLATION CONDITIONS ON THRUST REVERSERS PERFORMANCES
J M Hardy and J P Carre In AGARD Airframe/Propulsion Interference Mar 1975 11 p In FRENCH ENGLISH summary

Development of thrust reversers is generally carried out in engine test cells without external flow As thrust reversers deviate a significant amount of flow this modifies the aerodynamic field surrounding an aircraft Inversely flight speed as well as aircraft installation conditions react on the operating characteristics of thrust reversers This interaction is contingent on the thrust reversers design arrangement The interaction mechanisms is analyzed using test data collected with two types of thrust reversers during an investigation carried out on the CONCORDE afterbody The differences in behavior existing between the reversers are shown as revealed by tests carried out with no external flow and with external flow in the O N E R A wind tunnel installation An investigation on interaction mechanisms is presented bringing out a correlation parameter which makes it possible to extrapolate thrust reverser results obtained in static conditions for various running configurations A balance of deceleration forces are analyzed and the effects of flight Mach number on the reversers base pressure values are shown
                                                                Author

N75-23496 British Aircraft Corp (Operating) Ltd Bristol (England) Commercial Aircraft Div
REVERSE THRUST EXPERIENCE ON THE CONCORDE
A C Willmer and R L Scotland In AGARD Airframe/Propulsion Interference Mar 1975 15 p refs

Reverse thrust is used as a means of deceleration on many aircraft Partical limitations to its use are set by the following airframe/propulsion interference of hot gas ingestion and aircraft handling The reverse thrust force may also differ from that measured on a test bed due to interference Model tests to determine these interference effects for the Concorde aircraft were carried out The several test techniques used are described the model results are compared with those inferred from tests on the prototype and production aircraft   Author

N75-23497 Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany)
REYNOLDS NUMBER EFFECTS ON FORE- AND AFTBODY PRESSURE DRAG
Felix Aulehla and Geert Besigk In AGARD Airframe/Propulsion Interference Mar 1975 15 p refs

As analysis of a wind tunnel investigation at Mach number 0 8 on a series of axisymmetric bodies showed as a main result that varying Reynolds number produces opposite changes in pressure drag on fore- and aftbody respectively It is explained that this result could very well be caused by wind tunnel interference As a consequence to determine aftbody drag correctly it will be required either to test in interference free wind tunnels or to take into account the compensating effects on the forebody Furthermore it is pointed out that modifications in aftbody geometry affect forebody drag Results from the commonly used aftbody test rigs with forebodies fixed to the ground therefore need appropriate corrections Finally the sensitivity of drag components with respect to the location of split lines is discussed It is shown that subdividing the boattail is not advisable from an accuracy point of view   Author

N75-23498 Royal Aircraft Establishment Farnborough (England) Aerodynamics Dept
THE SUBSONIC BASE DRAG OF CYLINDRICAL TWIN-JET AND SINGLE-JET AFTERBODIES

J Reid A R G Mundell and J F W Crane In AGARD Airframe/Propulsion Interference Mar 1975 13 p refs

The effect was studied of forebody and support interference on the base drag of cylindrical twin-jet afterbodies in wind tunnel tests at subsonic speeds Two almost identical afterbodies were tested, one in a strong interference field and the other nearly free from interference The results illustrate the importance of the effect and also serve to test two methods of correction Supplementary tests show that the base drag of a cylindrical twin-jet afterbody tends to be a slightly greater than that of the equivalent axisymmetric configuration Finally a method of correlation is described whereby the base drag of both twin-jet and single-jet models may be expressed in linear form   Author

N75-23499 Tennessee Univ Space Inst Tullahoma
ON SOME PROBLEMS ENCOUNTERED IN A THEORETICAL STUDY OF THE EXTERNAL FLOW OVER A NOZZLE CONFIGURATION IN TRANSONIC FLIGHT
T H Moulden J M Wu and D J Spring (Army Missile Command) In AGARD Airframe/Propulsion Interference Mar 1975 12 p refs
(Contract DAAH01-74-C-0183)
Attention is drain to the lack of information both experimental and theoretical concerning the transonic flow over an engine configuration operating at various thrust levels It is shown that the flow is of great complexity In particular when the free stream Mach number is just supersonic it is found that the confluence between the jet and the external flow is still more nearly subsonic in nature This observation implies that the usual theories for supersonic base flow are not applicable to this situation Calculations from such a theory are presented and discussed in the light of experimental evidence It is recommended that considerable effort be spent in developing theoretical tools based upon solutions to more exact equations and that more fundamental experiments be performed   Author

N75-23500 Air Force Aero Propulsion Lab Wright-Patterson AFB Ohio
TWIN JET EXHAUST SYSTEM TEST TECHNIQUES
Ronald J Glidewell and Arthur E Fanning In AGARD Airframe/ Propulsion Interference Mar 1975 11 p refs

The problem of integrating airframe and propulsion system requires that the various wind tunnel models used in accomplishing the task simulate as accurately as possible the internal and external flowfields that will be experienced on the airplane itself This is particularly true for those models which are tested to define inlet and exhaust system interactions with the airplane flowfield Exact simulation is however prohibited by the limitations of wind tunnel test techniques For the jet effects model such limitations include the interference effects associated with the model support system exhaust plume simulation and the use of inlet fairings in substitution for flowing inlets Information from a variety of sources is used to assess the impact of these model limitations on the accuracy of afterbody performance measured on twin jet models   Author

N75-23501* National Aeronautics and Space Administration Langley Research Center Langley Station Va
AN EXPERIMENTAL STUDY OF JET EXHAUST SIMULATION
William B Compton III In AGARD Airframe/Propulsion Interference Mar 1975 11 p refs

Avail NTIS CSCL 01A
Afterbody drag predictions for jet aircraft are usually made experimentally with the jet exhaust flow simulated The physical gas properties of the fluid used for the model jet exhaust can affect the accuracy of simulation of the airplane s jet exhaust plume The effect of the accuracy of this simulation on afterbody drag was investigated by wind-tunnel tests with single engine model In addition to unheated air as the exhaust gas the decomposition products of three different concentrations of hydrogen peroxide were utilized The air jet simulation consistently resulted in higher boattail drag than hydrogen peroxide simulation

The differences in drag for the various exhaust gases are attributed to different plume shapes and entrainment properties of the gases The largest differences in drag due to exhaust gas properties were obtained for the combination of high transonic Mach numbers and high boattail angles For these conditions the current data indicate that the use of air to simulate a nonafterburning turbojet exhaust can result in an increase in afterbody amounting to 20 percent of the nonafterburning turbojet value   Author

N75-23502 Rolls-Royce Ltd Derby (England)   Installation Aerodynamics Section
A MODEL TECHNIQUE FOR EXHAUST SYSTEM PERFORMANCE TESTING
T D Coombes   *In* AGARD   Airframe/Propulsion Interference Mar 1975 12 p refs

An accurate model technique is described that was developed to measure the sum of gross thrust and afterbody drag for nozzle systems with single or two co-axial streams The rig uses air at ambient temperature and is designed to operate in the 9ft x 8ft transonic wind tunnel of the Aircraft Research Association Limited at Bedford Model test results are also presented to demonstrate the accuracy and repeatability of the rig and show the considerable progress that has been made in advancing the state of the art on exhaust systems for low specific thrust engines   Author

N75-23503 LTV Aerospace Corp Dallas Tex   Vought Systems Div
ISOLATING NOZZLE AFTERBODY INTERACTION PARAMETERS AND SIZE EFFECTS   A NEW APPROACH
S C Walker *In* AGARD Airframe/Propulsion Interference Mar 1975 8 p refs

A flight test of the A-7E airplane is reported along with associated wind tunnel tests comprising approximately one half of the long range program The difficulty of controlling parameters in flight was overcome by flying into the data point while allowing only slight variations in ambient pressure Wind tunnel tests were made in a 1 2 x 1 2 meter blowdown tunnel Models were run with both hot and cold exhaust One model was a wingless body of revolution, the second was a geometric representation of the airplane The flight test demonstrated the practicability of parameter control testing and showed applicability of stream thrust parameter to inflight engine performance evaluation Wind tunnel data show trends and general levels comparable to flight and have verified some areas in which development of corrections is necessary   Author

N75-23504 ARO, Inc Arnold Air Force Station Tenn
EXHAUST PLUME TEMPERATURE EFFECTS ON NOZZLE AFTERBODY PERFORMANCE OVER THE TRANSONIC MACH NUMBER RANGE
C E Robinson M D High and E R Thompson *In* AGARD Airframe/Propulsion Interference   Mar 1975 16 p refs Sponsored in part by AEDC

Results of an experimental research investigation on nozzle/afterbody drag are presented Experimental afterbody (and boattail) drag coefficients and pressure distributions are discussed for an isolated strut-mounted nozzle/afterbody model for the Mach number range from 0 6 to 1 5 The experimental data were obtained for the basic model with an air-cooled and a water-cooled ethylene/air combustor to provide hot-jet duplication as well as cold-jet simulation The temperature of the nozzle exhaust gas was varied from 530 R (294 4 K) (burner-off) to approximately 2500 R (1388 9 K) for several nozzle pressure ratios from jet-off to those corresponding to a moderately under-expanded exhaust plume The differences between the cold-jet and hot-jet results are significant and adjusting the cold-jet pressure ratio to correct for the changes in the jet specific heat ratio with temperature will account for most of the differences observed   Author

N75-23505 Boeing Co Wichita Kans
THE INFLUENCE OF NACELLE AFTERBODY SHAPE ON AIRPLANE DRAG

Walter J Rohling *In* AGARD Airframe/Propulsion Interference Mar 1975 14 p refs

A program to design and flight test quiet nacelles suitable for installation on JT3D powered 707 airplanes was conducted Design requirements for the quiet nacelle stated that the nacelle shall be flightworthy flight weight capable of being certificated to airworthiness standards and appropriate to the aircraft type The cruise performance flight tests and the additional performance diagnostic flight tests indicated an unnecessary performance penalty due to the nonoptimum aft translating sleeve and fan nozzle configuration An unfavorable angle-of-attack-sensitive interplay between the wing and nacelle aft sleeve flow fields was found at all cruise Mach numbers This penalty was the only significant item discovered during the flight test program which required correction to provide a viable retrofit nacelle configuration The diagnostic performance flight tests wind tunnel and exhaust system model tests are described that were conducted to define the required change and to obtain data on the cruise performance benefits that resulted from the change   Author

N75-23506* National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
REYNOLDS NUMBER EFFECTS ON BOATTAIL DRAG OF EXHAUST NOZZLES FROM WIND TUNNEL AND FLIGHT TESTS
Fred A Wilcox and Roger Chamberlin *In* AGARD Airframe/ Propulsion Interference Mar 1975 15 p refs

A family of nacelle mounted high angle boattail nozzles was tested to investigate Reynolds number effects on drag The nozzles were flown on a modified F-106B and mounted on scale models of an F-106 in a wind tunnel A 19- to 1-range of Reynolds number was covered as a result of the large size differences between models and by flying over a range of altitude In flight the nozzles were mounted behind J-85 turbojet engines Jet boundary simulators and a powered turbojet engine simulator were used on the wind tunnel models Data were taken at Mach numbers of 0 6 and 0 9 Boattail drag was found to be affected by Reynolds number The effect is a complex relationship dependent upon boundary layer thickness and nozzle boattail shape As Reynolds number was increased from the lowest values obtained with scale models boattail drag first increased to a maximum at the lowest flight Reynolds number and then decreased   Author

N75-23507 Boeing Aerospace Co Seattle Wash
ACCOUNTING OF AERODYNAMIC FORCES ON AIRFRAME/PROPULSION SYSTEMS
Michael E Brazier and William H Ball *In* AGARD Airframe/ Propulsion Interference Mar 1975 15 p refs

Proper accounting prediction and measurement of propulsion system installation corrections are essential for the successful development of advanced military aircraft The results are reported of recent studies which evaluate the methods used to predict measure and integrate the aerodynamic and propulsion forces within a force accounting procedure that provides maximum element visibility and accuracy and is applicable throughout an entire airplane development cycle Improved analysis techniques are described which provide more comprehensive and accurate predictions of inlet performance and nozzle/aftbody drag early in the preliminary design process Inlet analysis techniques make use of standardized data maps for obtaining complete inlet performance characteristics Nozzle/aftbody drag calculations are performed using a newly-developed truncated integral mean slope technique Effects of strut interference blockage model split-line locations and other factors which introduce uncertainties into airframe/propulsion system data are presented   Author

N75-23508 Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio
AIRFRAME/PROPULSION SYSTEM FLOW FIELD INTERFERENCE AND THE EFFECT ON AIR INTAKE AND EXHAUST NOZZLE PERFORMANCE
G K Richey L E Surber and J A Laughrey *In* AGARD

Airframe/Propulsion Interference   Mar 1975   31 p   refs

The interference between the airframe flow field and the internal/external flow in the air intakes and exhaust nozzles of high performance tactical aircraft is shown to have a significant impact on the performance and operating characteristics of these components and hence on overall aircraft performance The internal flow characteristics of an inlet system closely integrated with the airframe are strongly influenced by flow field nonuniformities generated by the airframe forebody and wing particularly at the higher angles of attack or yaw which modern tactical aircraft are capable of Comparisons are made of the inlet ambient (capture plane) flow field and pressure recovery steady state and dynamic inlet distortion at the simulated engine compressor face for both integrated (side mounted and fuselage or wing-shielded) and isolated inlet systems to quantitatively assess the airframe interference effects For the engine exhaust nozzles of closely integrated propulsion system/airframe configurations the major influence of the airframe flow field is associated with the alteration of the viscous and inviscid external flow in the nozzle region and its effect on external aftbody/nozzle drag A detailed discussion supported by experimental data shows the effects on airframe aftbody/nozzle pressure distributions and nozzle installed performance with respect to twin jet interference wing flow aircraft tail/control surfaces interfairings and free stream flow conditions   Author

N75-23509   Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Porz (West Germany)
DETAILED EXPERIMENTAL AND THEORETICAL ANALYSIS OF THE AERODYNAMIC INTERFERENCE BETWEEN LIFTING JETS AND THE FUSELAGE AND WING
G Schulz and G Viehweger   *In* AGARD Airframe/Propulsion Interference Mar 1975 13 p refs

An aircraft model of simple shape for pressure distribution measurements is used which allows the variation of all main geometrical parameters The jets reach Mach number 1 Measurements of the velocity directional flow field are added The pressure distributions as well as the flow directional field allow the physical interpretation of the several aerodynamic effects By integration of the pressure field the forces and moments caused by the jets are obtained The integration of the directional field leads to the stream lines of the complicated field of cross blown jets Theoretical momentum considerations enable the calculation of the jet path and lead to transcalculation rules for flow directional fields (downwash) from one dynamic pressure ratio to another   Author

N75-23510   Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Brunswick (West Germany)
PREDICTION OF THE OPTIMUM LOCATION OF A NACELLE SHAPED BODY ON THE WING OF A WING-BODY CONFIGURATION BY INVISCID FLOW ANALYSIS
S R Ahmed *In* AGARD Airframe/Propulsion Interference Mar 1975 12 p   refs
Some results of a basic study are presented which aims at the prediction of optimum location of a pylon-mounted engine nacelle on the wing of a wing-body configuration with the help of inviscid flow analysis The options considered are the underwing and overwing positions of the nacelle Varied parameters are its spanwise and chordwise location along the wing The criterion for the choice of the optimum location is the minimum possible induced drag of the wing-body-pylon-nacelle configuration The theoretical calculation of the inviscid flow is done by the so-called panel method Feasibility of these predictions for subcritical flow is checked on the basis of extensive pressure and force measurements in a wind tunnel   Author

N75-23511   Vereinigte Flugtechnische Werke-Fokker G m b H Bremen (West Germany)
AIRFRAME   ENGINE INTERACTION FOR ENGINE CONFIGURATIONS MOUNTED ABOVE THE WING PART 1 INTERFERENCE BETWEEN WING AND INTAKE JET

G Krenz *In* AGARD Airframe/Propulsion Interference Mar 1975 32 p refs
Advanced technology of airframe-propulsion-integration confirm the feasibility for over-the-wing engine installation of transport aircraft Basic areas of interaction between wing and engine flows are described together with specific investigations associated with fore and aft engine locations For the aft location, W/T results are presented with flight test data including stall and high speed flight characteristics Further low speed tunnel investigations of aircraft configurations with engine intakes well in front of wing L E result in increasing lift as well as improving the lift/drag ratio during T/O and landing A theoretical approach was conducted using the well established panel method and comparison of theoretical and experimental pressure distributions proved well for spacing of one nozzle diameter between the wing and nozzle-jet sheet   Author

N75-23512 Vereinigte Flugtechnische Werke-Fokker G m b H Bremen (West Germany)
AIRFRAME   ENGINE INTERACTION FOR ENGINE CONFIGURATIONS MOUNTED ABOVE THE WING PART 2 ENGINE JET SIMULATION PROBLEMS IN WIND TUNNEL TESTS
B Ewald *In* AGARD Airframe/Propulsion Interference   Mar 1975 17 p refs
A test technique developed for the VFW-Fokker low speed wind tunnel is presented In this technique the airframe model is mounted to the external mechanical balance (wire suspension) The engine pod is mounted separately on a tail sting suspension system Due to the design of this tail sting system its angle of attack axis of rotation coincides with the corresponding axis of the external balance So separate mounting of airframe and engine with very small gaps is possible The air is fed to the engine pod with high pressure (up to 20 atmospheres) This pressure is decreased to the required nozzle exit pressure ratio by perforated plates very close to the nozzle exit Calibration results of this nozzle arrangement are given Typical test results (force measurements wing pressure distribution) are presented for several engine locations (over-wing on-wing under-wing)
                                                                    Author

N75-23513 Messerschmitt-Boelkow-Blohm G m b H   Munich (West Germany)
AERODYNAMIC ASPECTS AND OPTIMISATION OF THRUST REVERSER SYSTEMS
Kurt Lotter and Wolfgang Kurz *In* AGARD Airframe/Propulsion Interference Mar 1975 22 p ref

The present generation of commercial aircraft and future advanced military aircraft require thrust reversal for reduction of landing distances especially for wet or icy runways The various design and integration features for jet deflection are summarized and the requirements and problem areas discussed under special consideration of a target type reverser system The important engine/airframe interference problems and aerodynamic aspects associated with thrust reversal are considered Parametric investigation of thrust reverser geometry on efficiency reingestion structure heating and longitudinal stability during ground roll is presented Results are based on an intensive wind tunnel test program using various types of scale models with cold and hot jets intake suction and fixed and moving ground simulation Emphasis is given to the overall optimization of often conflicting requirements from parameters like for example thrust reverser performance and reingestion The essential influence of appropriate thrust reverser operation and landing techniques at or shortly before touch-down on landing distance is shown   Author

N75-23514*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
EFFECT OF WING PLANFORM AND CANARD LOCATION AND GEOMETRY ON THE LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF A CLOSE-COUPLED CANARD WING MODEL AT SUBSONIC SPEEDS
Blair B Gloss Washington Jun 1975 86 p refs
(NASA-TN-D-7910 L-9987) Avail NTIS   HC $4 75   CSCL 01A

A generalized wind-tunnel model with canard and wing planforms typical of highly maneuverable aircraft was tested in the Langley 7- by 10-foot high-speed tunnel at a Mach number of 0 30 to determine the effect of canard location canard size wing sweep and canard strake on canard-wing interference to high angles of attack The major results of this investigation may be summarized as follows the high-canard configuration (excluding the canard strake and canard flap), for both the 60 deg and 44 deg swept leading-edge wings produced the highest maximum lift coefficient and the most linear pitching-moment curves substantially larger gains in the canard lift and total lift were obtained by adding a strake to the canard located below the wing chord plane rather than by adding a strake to the canard located above the wing chord plane   Author

N75-23516#   Max-Planck-Institut fuer Stroemungsforschung Goettingen (West Germany)
UNSTEADY BEHAVIOR OF TRANSONIC FLOWS
Gerd E A Meier 1974 138 p refs In GERMAN ENGLISH summary
(MPIS-Mitt-59) Avail NTIS HC $5 75 Max-Planck-Inst fuer Stroemungsforsch Goettingen West Ger 26 40 DM
Transonic flows in a curved tunnel, on wings and in Laval-type nozzles were investigated They show similar nonsteady behavior where fluctuation of quantities of state occur which are more than 10 percent The oscillation is generated by a local instability which is based on an interaction of the boundary layer and the shock wave at the end of the supersonic flow regime Using a one-dimensional treatment of the steady nozzle flow one can establish an essential criterion for the occurrence of the instability of the shock induced separated flow The frequency of the oscillations is determined by several propagation processes The change in boundary conditions caused by displacement of the separation is propagated into the main flow field by the speed of sound and flow velocity Changes in the back-flow regime are propagated mainly with the flow and back-flow velocity From this experimental evidence oscillation periods can be estimated for all cases which are experimentally observed   Author (ESRO)

N75-23518#   Air Force Systems Command Wright-Patterson AFB Ohio   Foreign Technology Div
ACCOUNT OF SHEARING STRAIN DURING THE CALCULA-TION OF THE OSCILLATIONS OF LOW ASPECT-RATIO WING BY THE METHOD OF POLYNOMIALS
V G Bunkov 18 Feb 1975 33 p refs Transl into ENGLISH from Uch Zap Tsent Aerogidrodinamicheskii Inst (USSR), v 3 no 4 1972 p 111-119
(AD-A007397 FTD-MT-24-0557-75) Avail NTIS CSCL 01/1
The application of the polynomial method to the calculation of oscillation and flutter for short wing aspect ratios is discussed The method is described as a generalization of Ritz s method with the expansion of deformation in power series   Author

N75-23519#   Air Force Systems Command Wright-Patterson AFB Ohio   Foreign Technology Div
INTERACTION OF SHOCK WAVE WITH WEDGE, WHICH MOVES AT SUPERSONIC SPEED
R Ya Tugazakov 12 Feb 1975 24 p refs Transl into ENGLISH from Uch Zap Tsentr Aerogidrodinamicheskii Inst (USSR), v 2 no 2 1971 p 34-39
(AD-A007324 FTD-MT-24-0343-75) Avail NTIS CSCL 01/1
The problem of incidence during shock wave interaction with a wedge moving at supersonic speed was examined along with flow when bow shock pressure and incident shock are identical Gas parameters in the interaction wave region were calculated using the method of characteristics   Author

N75-23520#   Air Force Systems Command Wright-Patterson AFB Ohio   Foreign Technology Div
REPRODUCTION OF THE INTERACTION OF AERODY-NAMIC LOADS AND STRUCTURAL DISTORTIONS DURING STRENGTH TESTS
G N Zamula and P V Miodushevskii 24 Jan 1975 26 p refs Transl into ENGLISH from Tsentr Aerogidrodinamicheskii

Inst , Uch Zap (USSR), v 3 no 4, 1972 p 158-163
(AD-A007661 FTD-MT-24-0564-75) Avail NTIS CSCL 01/1
The simulation of the interaction of aerodynamic loads and structural deformation is discussed for testing structural strength   Author

N75-23521#   Air Force Systems Command Wright-Patterson AFB Ohio   Foreign Technology Div
METHOD OF THE OPTIMIZATION OF THE LOAD-CARRYING STRUCTURE OF WING ON RIGIDITY DURING VARIATION BY THE DISTRIBUTION OF THICKNESS RATIO
G V Ukraintsev and V M Frolov 27 Jan 1975 34 p Transl into ENGLISH from Uch Zap Tsagi (USSR), v 3 no 4 1972 p 65-76
(AD-A007317 FTD-MT-24-0553-75) Avail NTIS CSCL 01/1
A method proposed for the optimization of the load carrying structure of a wing is discussed The procedure will determine the greatest flexual rigidity variation as a function of relative thickness -of-the power material under conditions of weight constancy and satification of some aerodynamic limitations
          Author

N75-23522#   Naval Air Development Center Warminster Pa Air Vehicle Technology Dept
FLIGHT TEST FOR THE FEASIBILITY EVALUATION OF THE CHADWICK ELECTRONIC WEIGHING SYSTEM (CHEWS) Final Report
William Bollinger and William Mawhinney 14 Jan 1975 54 p refs
(AD-A007516 NADC-74234-30) Avail NTIS CSCL 01/3
This report presents the procedures and results of the flight testing of the Chadwick Electronic Weighing System (CHEWS) The consensus of opinions from pilot questionnaires concerning the system is discussed A more extensive flight test program is recommended   GRA

N75-23524#   Air Force Systems Command Wright-Patterson AFB Ohio   Foreign Technology Div
EXPERIMENTAL STUDY OF HEAT TRANSFER DURING FLOW AROUND UNCAMBERED DELTA WINGS WITH BLUNTED EDGES
N A Davydova and A Ya Yushin 8 Jan 1975 34 p refs Transl into ENGLISH from Tsentr Aerogidrodinamicheskii Inst , Uch Zap (USSR) v 1 1970 p 117-125
(AD-A007316 FTD-MT-24-267-75) Avail NTIS CSCL 01/1
Discrete calorimetric sensors were used along with heat sensitive paint to make heat transfer measurements of the supersonic flow around uncambered delta wings at various Mach numbers The effect of angle of attack and degree of bluntness of the cylindrical edges on heat transfer to the wing is investigated It is shown that the available engineering methods of calculation of heat exchange can be utilized to evaluate heat transfer intensity on wing   Author

N75-23525#   Air Force Systems Command Wright-Patterson AFB Ohio   Foreign Technology Div
CALCULATION OF LOADS AND DEFORMATIONS OF SWEPTBACK WING WITH THE AID OF MECHANICAL ANALOG INSTRUMENTS
B L Merkulov 27 Jan 1975 21 p refs Transl into ENGLISH from Tsentr Aerogidrodinamicheskii Inst Uch Zap (USSR) v 3 no 5 1972 p 119-123
(AD-A007308 FTD-MT-24-0544-75) Avail NTIS CSCL 01/1
The possibility of applying mechanical analog instruments to the study of pressure distributions on the surface of a streamlined body and to the calculation of elastic deformations of sweptback wings are examined Approximation formulas are proposed which determine the relationship between the aero-dynamic coefficients of sections perpendicular to the axis of the wing and the coefficients of sections parallel to the planes of symmetry of the aircraft   Author

N75-23526# Chrysler Corp New Orleans La Data Management Services
AN EXPERIMENTAL INVESTIGATION OF THE AERODYNAMIC CHARACTERISTICS OF SEVERAL NOSE MOUNTED CANARD CONFIGURATIONS AT SUPERSONIC MACH NUMBERS
James R Burt Jr 30 Jan 1975 621 p refs
(Contract DAAH03-74-C-0405 DA Proj 1M2-62303-A-214)
(AD-A007793 DMS-AR-1023, RD-75-17) Avail NTIS CSCL 16/4

Experimental aerodynamic investigations were conducted at the Ames 6- by 6-foot supersonic wind tunnel to determine the aerodynamic characteristics of several nose mounted canard wing configurations Canard position, geometry angular orientation, and model nose shape were varied systematically to determine their effects on model aerodynamics The model was tested at angles of attack of -3 to 12 degrees and Mach Numbers of 1 5 and 2 0 Aerodynamic loads were measured separately on four canards and tail panels and the total model The vapor screen method was used to trace the paths of the vortices shed from the canards GRA

N75-23527# Naval Intelligence Support Center Washington, D C Translation Div
WING LONGITUDINAL STABILITY CRITERIA
R D Irodov 13 Feb 1975 19 p refs Transl into ENGLISH from Tsentr Aerogidrodinamicheskii Inst Uch Zap (USSR) v 1 no 4, 1970 p 63-72
(AD-A007430 NISC-Trans-3631) Avail NTIS CSCL 01/3

The longitudinal stability of a wing in ground effect machines is discussed in terms of aerodynamic configurations Author

N75-23528# United Aircraft Corp East Hartford, Conn Research Labs
PREDICTION OF ROTOR WAKE INDUCED FLOW ALONG THE ROCKET TRAJECTORIES OF AN ARMY AH-1G HELICOPTER Final Report, Dec 1973 - Feb 1975
Anton J Landgrebe and T Alan Egolf Mar 1975 102 p refs
(Contract DAAA21-74-C-0195)
(AD-A007878 UARL-R911810-10 PA-TR-4797) Avail NTIS CSCL 01/1

An analytical investigation was conducted to predict the rotor wake induced flow velocities along the trajectories of rockets fired from an Army AH-1G helicopter Three components of both the time-averaged and instantaneous induced velocities were predicted at selected points along the trajectories of rockets fired from four wing locations Three flight conditions with helicopter flight speeds of 0 15 and 30 knots were investigated GRA

N75-23529# Naval Intelligence Support Center Washington D C Translation Div
HYDROAERODYNAMIC CHARACTERISTICS OF A LOW ASPECT RATIO DELTA WING NEAR A SCREEN
A G Kostin 14 Mar 1975 10 p refs Transl into ENGLISH from Gidrodinam Bolshikh Skorostei (USSR), no 5 1968 p 113-120
(AD-A007649 NISC-Trans-3643) Avail NTIS CSCL 01/1

An analytical theory was developed to obtain hydrodynamic coefficients of a low aspect ratio delta wing near a screen The general representation of the potential velocity of the theory includes all known results as a zero approximation wing in plane parallel flow Wing camber effects on the coefficients are studied Author

N75-23530# Rome Air Development Center Griffiss AFB N Y
FAA LIGHTNING PROTECTION STUDY LIGHTNING

PROTECTION REQUIREMENTS FOR AIL TYPE 55 K INSTRUMENT LANDING SYSTEM Final Report, 1 Jan 1974 - 1 Jan 1975
Richard H Hu Andrew W Revay Jr and Richard M Cosel Jan 1975 45 p refs
(Contract DOT-FA72WAI-356)
(AD-A008931 FAA-RD-75-47) Avail NTIS HC $3 75

The degree of susceptibility of the FAA AIL Type 55 K electronic instrument landing system to electromagnetic pulse effects due to lightning and the devices and methods proposed to deal with the problem are examined Lightning protection requirements types of susceptible components methods used to determine component withstand capabilities and recommendations for specific protection devices and circuitry are covered Appendices include a bibliography of sources used for reference and complete circuit and block diagrams of the affected subsystems Author

N75-23531# Mitre Corp McLean Va
AN OVERVIEW AND ASSESSMENT OF PLANS AND PROGRAMS FOR THE DEVELOPMENT OF THE UPGRADED THIRD GENERATION AIR TRAFFIC CONTROL SYSTEM
Mar 1975 225 p refs Revised
(Contract DOT-FA70WA-2448)
(AD-A008940 M73-237-Rev-1 FAA-EM-75-5) Avail NTIS HC $7 50

Information on the scope, rationale costs schedules and possible benefits of the air traffic control system being developed for operational use in the 1980 s and into the 1990 s is presented The ATC system currently in use is described and the need for improvements is identified The goals and objectives of the upgrade system are discussed Forecasts of future air traffic through 1975 are shown The major features of the air traffic control system are traffic control system are discussed including need objectives, technical description benefits major issues implementation considerations benefits and schedules major milestones and resource requirements through FY83 The way in which each major feature contributes toward achieving the overall goals and objectives is discussed Overall development costs are presented along with gross estimates of F&E costs Author

N75-23533*# Scientific Translation Service Santa Barbara Calif
HIGH-CAPACITY TRANSPORT PLANES AS MODERN AIR FREIGHT SYSTEMS
Helmuth M Weiss Washington NASA Jun 1975 15 p refs Transl into ENGLISH from Forden und Heben (West Germany) v 22 no 2, 1972 p 97-100
(Contract NASw-2483)
(NASA-TT-F-16396) Avail NTIS HC $3 25 CSCL 01C

The development of large-capacity transport planes in the U S and U S S R with freight air containers is seen as ushering in complete air freight systems with world-wide capacity Recovery rates were observed in Swiss gravel mines to be raised by continuously operating bucket wheel type 100 dredges Extensions and improvements were made to the type GK 81/UB 600 mobile crane oil-hydraulic container elevators and explosion-proof compressed-air hoists Author

N75-23534*# Douglas Aircraft Co Inc Santa Monica Calif
ANALYSIS OF OPERATIONAL REQUIREMENTS FOR MEDIUM DENSITY AIR TRANSPORTATION VOLUME 1 SUMMARY
Mar 1975 166 p refs
(Contract NAS2-8135)
(NASA-CR-137603 MDC-J4484-Vol-1) Avail NTIS HC $6 25 CSCL 01B

The medium density air travel market was studied to determine the aircraft design and operational requirements The impact of operational characteristics on the air travel system and the economic viability of the study aircraft were also evaluated Medium density is defined in terms of numbers of people transported (20 to 500 passengers per day on round trip routes) and frequency of service (a minimum of two and maximum of eight round trips per day) for 10 regional carriers The operational characteristics of aircraft best suited to serve the medium density air transportation market are determined

and a basepoint aircraft is designed from which tradeoff studies and parametric variations could be conducted The impact of selected aircraft on the medium density market economics and operations is ascertained Research and technology objectives for future programs in medium density air transportation are identified and ranked   Author

N75-23539# Air Force Technical Applications Center Washington D C   Foreign Technology Div
EMERGENCY EJECTION, SEQUENCE OF OPERATION
3 Mar 1975 17 p Transl into ENGLISH from the monograph Beskrivning och handhavande   Sweden
(AD-A007470 FTD-HC-23-0867-75) Avail NTIS CSCL 01/3
      The chair ejection sequence and parachute deployment are given   Author

N75-23540# Operational Research and Analysis Establishment Ottawa (Ontario)
ANALYSIS OF DISTRESS AIR CASES IN RELATION TO CRASH POSITION AND INTENDED TRACK   1968 - 1973
R P Hypher E J Edmond and E C ONeill   Aug 1974 63 p
(AD-A007429 ORAE-R51) Avail NTIS CSCL 01/3
      In distress air cases in which an aircraft crashes or force lands without revealing its position search methods are prescribed by Canadian Forces Search and Rescue Orders and Procedures (CFP 209) This paper examines the relationship between crash position and various parameters of the intended flight (Origin or Last Known Position Track and Destination) A method for determining the search area is devised and compared with the existing method embodied in CFP 209 The proposed method produces search areas which are smaller than the present areas for a corresponding probability of coverage The overall reduction in areas is anticipated to be about 35% over a wide spectrum of cases and a period of time   On the assumption that search time is related to area a reduction in search time of this order of magnitude is expected   GRA

N75-23541# Naval Air Development Center Warminster Pa
A CRASHWORTHY ARMORED PILOT SEAT FOR HELICOPTERS Final Report
Bernard Mazelsky 18 Jan 1974 131 p refs
(AD-A007551 NADC-74018-40 USAAVSCOM-TR-73-34) Avail NTIS CSCL 01C
      The accelerations which can occur during crashes of rotary- and light fixed-wing aircraft have been shown to be injurious or fatal to human occupants Under a joint Army and Navy program ARA Inc developed a crash survivable seat using Government Furnished Equipment in the form of an armored bucket restraint system and cushions The seat system was designed to meet as many of the requirements of MIL-S-58095 (AV) within the physical limitations of existing space requirements in present helicopters   GRA

N75-23543*# Analytical Mechanics Associates Inc Mountain View Calif
A KALMAN FILTER FOR THE STOLAND SYSTEM
Stanley F Schmidt Apr 1975 67 p refs
(Contract NAS2-8503)
(NASA-CR-137668 Rept-75-10) Avail NTIS HC $4 25 CSCL 17G
      A simple Kalman filter for potential use in STOL navigation systems is described The mathematical formulation of all the elements of the filter its initialization and overall operation are presented Simulation results show that a typical approach flight to landing the Kalman filter has much smaller errors during navigation on TACAN data and during transition from TACAN to MODILS data than a complementary filter Summary type flow charts of the Kalman filter logic designed for the Sperry 1819A computer are presented Also the memory and real time requirements of the Kalman filter and complementary filter are

described The Kalman filter is shown to gain its superior performance at the expense of real time and memory required in the onboard computer   Author

N75-23544*# United Air Lines Inc Denver Colo
IMPLICATIONS OF EQUIPPING A DC-8-61 FLEET WITH RNAV/TWO-SEGMENT APPROACH AVIONICS
Erik B Anderson Feb 1975 14 p refs
(Contract NAS2-7475)
(NASA-CR-137680) Avail NTIS HC $3 25 CSCL 17G
      Due to the costs of implementing two-segment approaches with special purpose computers and the fact that such systems rely on special ground equipment not generally in use today it is useful to consider the possibility of adding a two-segment approach capability to area navigation (RNAV) systems The addition of the capability to provide two-segment approach navigation in an RNAV system which already interfaces with the standard instrument landing system is estimated to cost $1430 per aircraft This includes the cost to add an approach progress display to make necessary modifications to RNAV software and to develop special approach plates   Author

N75-23549*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
FOUR-DIMENSIONAL GUIDANCE ALGORITHMS FOR AIRCRAFT IN AN AIR TRAFFIC CONTROL ENVIRONMENT
Thomas Pecsvaradi Washington Mar 1975 140 p refs
(NASA-TN-D-7829 A-5530) Avail NTIS HC $5 75 CSCL 01B
      Theoretical development and computer implementation of three guidance algorithms are presented From a small set of input parameters the algorithms generate the ground track altitude profile and speed profile required to implement an experimental 4-D guidance system Given a sequence of waypoints that define a nominal flight path the first algorithm generates a realistic flyable ground track consisting of a sequence of straight line segments and circular arcs Each circular turn is constrained by the minimum turning radius of the aircraft The ground track and the specified waypoint altitudes are used as inputs to the second algorithm which generates the altitude profile The altitude profile consists of piecewise constant flight path angle segments each segment lying within specified upper and lower bounds The third algorithm generates a feasible speed profile subject to constraints on the rate of change in speed permissible speed ranges and effects of wind Flight path parameters are then combined into a chronological sequence to form the 4-D guidance vectors These vectors can be used to drive the autopilot/ autothrottle of the aircraft so that a 4-D flight path could be tracked completely automatically or these vectors may be used to drive the flight director and other cockpit displays thereby enabling the pilot to track a 4-D flight path manually   Author

N75-23550# Federal Aviation Administration Washington D C Office of Systems Engineering Management
ENGINEERING AND DEVELOPMENT PROGRAM PLAN, EN ROUTE CONTROL
Feb 1975 92 p
(AD-A007623 FAA-ED-12-2A) Avail NTIS HC $4 75 CSCL 17G
      Implementation of the third generation en route ATC system Model A3d2 provides basic automation capability for processing flight data and surveillance functions Substantial upgrading of this basic capability is needed to meet the demand forecast for the en route system through the 1970 s and into the 1980 s This document describes the development plan to build the features and functions necessary for upgrading the present third generation en route system Program objectives development activities implementation considerations and resource estimates are set forth   Author

N75-23554 Purdue Univ Lafayette Ind
COMPUTER-AUGMENTED DESIGN OF AIRCRAFT WING

STRUCTURES Ph D Thesis
Pramote Tiewtranon 1974 144 p
Avail Univ Microfilms Order No 75-10971

A design procedure for aircraft wing structure which consists of supplying a set parameters to describe the wing geometry and optimizing the weight of the structure is developed A computer display terminal is used to monitor the progress of the design procedure All computations are automated and results are visually represented by the display terminal in the form of graphs, figures or numbers
Dissert Abstr

N75-23555*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va
THE EFFECT OF CHINE TIRES ON NOSE GEAR WATER-SPRAY CHARACTERISTICS OF A TWIN ENGINE AIR-PLANE
Thomas J Yager Sandy M Stubbs and John L McCarty May 1975 26 p
(NASA-TM-X-72695) Avail NTIS HC $3 75 CSCL 01C

An experimental investigation was performed to evaluate the effectiveness of nose gear chine tires in eliminating or minimizing the engine spray ingestion problem encountered on several occasions by the Merlin 4 a twin-engine propjet airplane A study of the photographic and television coverage indicated that under similar test conditions the spray from the chine tires presented less of a potential engine spray ingestion problem than the conventional tires Neither tire configuration appeared to pose any ingestion problem at aircraft speeds in excess of the hydroplaning speed for each tire however significant differences were noted in the spray patterns of the two sets of tires at sub-hydroplaning speeds At sub-hydroplaning speeds the conventional tires produced substantial spray above the wing which approached the general area of the engine air inlet at lower test speeds The chine tires produced two distinct spray plumes at sub-hydroplaning speeds one low-level plume which presented no apparent threat of ingestion and one which at most test speeds was observed to be below the wing leading edge and thus displaced from the intakes on the engine nacelle
Author

N75-23556*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va
A STUDY OF HELICOPTER INTERIOR NOISE REDUCTION
James T Howlett and Sherman A Clevenson May 1975 8 p refs Presented at the 31st Ann Natl Forum of the Amer Helicopter Soc May 1975
(NASA-TM-X-72655 L-10076) Avail NTIS HC $3 25 CSCL 01C

The interior noise levels of existing helicopters are discussed along with an ongoing experimental program directed towards reducing these levels Results of several noise and vibration measurements on Langley Research Center s Civil Helicopter Research Aircraft are presented including measurements taken before and after installation of an acoustically-treated cabin The predominant noise source in this helicopter is the first stage planetary gear-clash in the main gear box both before and after installation of the acoustically treated cabin Noise reductions of up to 20 db in some octave bands may be required in order to obtain interior noise levels comparable to commercial jet transports
Author

N75-23557*# National Aeronautics and Space Administration Ames Research Center Moffett Field, Calif
CORRELATION OF LOW SPEED WIND TUNNEL AND FLIGHT TEST DATA FOR V/STOL AIRCRAFT
Woodrow L Cook and David H Hickey Apr 1975 13 p refs
(NASA-TM-X-62423 A-5998) Avail NTIS HC $3 25 CSCL 01C

The XV-5B fan-in-wing aircraft and the YOV-10 RCF rotating cylinder flap aircraft were subjected to wind tunnel tests These tests were conducted specifically to provide for correlation between wind tunnel and inflight aerodynamics and noise test data Correlation between aerodynamic and noise data are presented and testing techniques that are related to the accuracy of the data or that might affect the correlations are discussed
Author

N75-23558*# Rockwell International Corp Los Angeles Calif
DESIGN AND ANALYSIS OF A SUPERSONIC PENETRA-TION/MANEUVERING FIGHTER
R D Child Apr 1975 182 p refs
(Contract NAS1-13496)
(NASA-CR-132633) Avail NTIS HC $7 00 CSCL 01B

The design of three candidate air combat fighters which would cruise effectively at freestream Mach numbers of 1 6 2 0 and 2 5 while maintaining good transonic maneuvering capability is considered These fighters were designed to deliver aerodynamically controlled dogfight missiles at the design Mach numbers Studies performed by Rockwell International in May 1974 and guidance from NASA determined the shape and size of these missiles The principle objective of this study is the aerodynamic design of the vehicles however configurations are sized to have realistic structures mass properties and propulsion systems The results of this study show that air combat fighters in the 15 000 to 23 000 pound class would cruise supersonically on dry power and still maintain good transonic maneuvering performance
Author

N75-23559*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
EFFECT OF CANARD POSITION AND WING LEADING-EDGE FLAP DEFLECTION ON WING BUFFET AT TRAN-SONIC SPEEDS
Blair B Gloss William P Henderson and Jarrett K Huffman 16 Apr 1974 92 p refs
(NASA-TM-X-72681) Avail NTIS HC $4 75 CSCL 01C

A generalized wind-tunnel model with canard and wing planform typical of highly maneuverable aircraft was tested The addition of a canard above the wing chord plane for the configuration with leading-edge flaps undeflected produced substantially higher total configuration lift coefficients before buffet onset than the configuration with the canard off and leading-edge flaps undeflected The wing buffet intensity was substantially lower for the canard-wing configuration than the wing-alone configuration The low-canard configuration generally displayed the poorest buffet characteristics Deflecting the wing leading-edge flaps substantially improved the wing buffet characteristics for canard-off configurations The addition of the high canard did not appear to substantially improve the wing buffet characteristics of the wing with leading-edge flaps deflected
Author

N75-23560# Air Force Systems Command Wright-Patterson AFB Ohio Foreign Technology Div
CALCULATION OF THE REINFORCED THIN-WALLED CONSTRUCTION BY THE METHOD OF THE FINAL ELEMENT
Yu I Ivanov 14 Feb 1975 36 p refs Transl into ENGLISH from Tsent Aerogidrodinamicheskii Inst Uch Zap (USSR) v 3, no 1 1972 p 51-60
(AD-A007307 FTD-MT-24-0427-75) Avail NTIS CSCL 01/3

The finite element method is utilized to study various reinforced thin-walled aircraft structures Examples of calculations are given of a series of constructions to illustrate the possibilities of the method
J M S

N75-23562# United Aircraft Corp, Stratford Conn Sikorsky Aircraft Div
ADVANCED OVERRUNNING CLUTCH TECHNOLOGY, DESIGN PHASE Technical Report, Mar - Oct 1974
Jules Kish 1974 97 p refs
(Contract DAAJ02-74-C-0028)
(AD-A007815) Avail NTIS CSCL 13/9

This report discusses the results of the definition of require-ments and design phases of the Advanced Overrunning Clutch Technology program conducted by Sikorsky Aircraft for the Eustis Directorate The purpose of this program is to develop helicopter overrunning clutches for use at engine speeds Current practice is to design the free-wheel unit to operate at the second stage of gearing with speeds from 6 000 .. 0 000 rpm At the engine speed torque is lower and hence the free-wheel unit will be lighter
GRA

N75-23563# Air Force Aero Propulsion Lab Wright-Patterson AFB Ohio
PARAMETRIC ANALYSIS OF AN ADVANCED MANNED INTERCEPTOR UTILIZATION Final Report, Mar -Nov 1973
Norman A Hirsch Jan 1975 101 p refs
(AD-A007663 AFAPL-TR-74-42) Avail NTIS CSCL 15/3

This report parametrically reviews the interceptor and patrol aircraft requirements to adequately defend the CONUS against penetrating aircraft with a stand off missile and subsequently reviews the interceptor and patrol aircraft requirements to assure patrol aircraft survivability against the same penetrating aircraft with an air-to-air missile In the first situation the only consideration is CONUS defense without regard for patrol aircraft survivability while the latter considered both CONUS defense and patrol aircraft survivability GRA

N75-23564# Defence and Civil Inst of Environmental Medicine Downsview (Ontario) Behavioural Sciences Div
CF5D AIRCRAFT COCKPIT-NOISE REDUCTION
S E Forshaw and S W Olsen Sep 1974 39 p refs
(DCIEM-74-R-1048) Avail NTIS HC $3 75

A sound survey was conducted in a modified CF5D aircraft to determine the effectiveness of prototype floor and torso-valve mufflers in reducing the noise produced by the cockpit air conditioner The noise levels in the rear cockpit of a modified aircraft were about 6 10 and 12 dBA less, for air-conditioner settings full cold 60 F' and full hot respectively than in an unmodified aircraft flown under identical conditions Author

N75-23565# Aeronautical Systems Div Wright-Patterson AFB Ohio
THE STATE OF THE ART IN OIL QUALITY GAGING ON US MILITARY AND COMMERCIAL AIRCRAFT
John W Long Sep 1974 45 p refs
(AD-A007682 ASD-TR-74-39) Avail NTIS CSCL 01/3

This report reviews the principal design techniques used in oil quantity gaging systems for U S military and commercial aircraft The most pertinent design details of four oil quantity gaging systems are discussed and the author s opinion as to the merits of certain characteristics of each design is given based upon the potential of the basic design while operating in military environments An attempt is made to rate each of the four designs in the following areas adequacy of performance vulnerability to military aircraft environments, simplicity of design and reproducibility and maintainability GRA

N75-23567*# Texas A&M Univ College Station Texas Engineering Experiment Station
IMPROVEMENT OF PROPELLER STATIC THRUST ESTIMATION Final Report
J Brusse and C F Kettleborough May 1975 28 p refs
(Grant NGR-44-001-011)
(NASA-CR-132680) Avail NTIS HC $3 75 CSCL 03C

The problem of improving the performance estimation of propellers operating in the heavily loaded static thrust condition was studied The Goldstein theory was assessed as it applies to propellers operating in the static thrust A review of theoretical considerations is presented along with a summary of the attempts made to obtain a numerical solution The chordwise pressure distribution was determined during operation at a tip speed of 500 ft/sec Chordwise integration of the pressures leads to the spanwise load distribution and further integration would give the axial thrust Author

N75-23568*# Lockheed-California Co Burbank
CONCEPTUAL DESIGN STUDY OF ADVANCED ACOUSTIC COMPOSITE NACELLE Final Report, Jun 1974 - Feb 1975
R G Goodall and G W Painter May 1975 241 p refs
(Contract NAS1-13233)
(NASA-CR-132649 LR-27113) Avail NTIS HC $7 50 CSCL 21A

Conceptual nacelle designs for wide-bodied and for advanced-technology transports were studied with the objective of achieving significant reductions in community noise with minimum penalties in airplane weight cost and in operating expense by the application of advanced composite materials to nacelle structure and sound suppression elements Nacelle concepts using advanced liners annular splitters radial splitters translating centerbody inlets and mixed-flow nozzles were evaluated and a preferred concept selected A preliminary design study of the selected concept a mixed flow nacelle with extended inlet and no splitters, was conducted and the effects on noise direct operating cost and return on investment determined Author

N75-23569*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
FULL SCALE UPPER SURFACE BLOWN FLAP NOISE
L J Heidelberg L Homyak and W L Jones 1975 28 p refs Presented at the Natl Air Transportation Meeting Hartford Conn 6-8 May 1975 sponsored by the Soc of Automotive Engr
(NASA-TM-X-71708 E-8322) Avail NTIS HC $3 75 CSCL 20A

A highly noise suppressed TF 34 engine was used to investigate the noise of several powered lift configurations involving upper surface blown (USB) flaps The configuration variables were nozzle type (i e slot and circular with deflector) flap chord length and flap angle The results of velocity surveys at both the nozzle exit and the flap trailing edge are also presented and used for correlation of the noise data Configurations using a long flap design were 4 db quieter than a short flap typical of current trends in USB flap design The lower noise for the long flap is attributed primarily to the greater velocity decay of the jet at the flap trailing edge The full-scale data revealed substantially more quadrupole noise in the region near the deflected jet than observed in previous sub-scale tests Author

N75-23570*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
NASA REFAN PROGRAM STATUS
K L Abdalla and J A Yuska 1975 35 p refs Presented at the Air Transportation Meeting Hartford Conn 6-8 May 1975 sponsored by Soc of Automotive Eng
(NASA-TM-X-71705) Avail NTIS HC $3 75 CSCL 21E

The objective of the refan program is to demonstrate the technical feasibility of substantially reducing the noise levels of existing JT8D powered aircraft The program consists of the design manufacturing and testing of the refan engines and modified nacelles and airplanes Experimental testing was completed for the refan engine both at sea level and at altitude conditions Ground testing for the B727 side- and center-engine installations and flight testing of the DC-9 with refan engines and acoustic nacelles were performed Preliminary results presented show that substantial noise reductions were achieved Author

N75-23573*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
AN APPLICATION OF MODERN CONTROL THEORY TO JET PROPULSION SYSTEMS
Walter C Merrill May 1975 154 p refs
(Grant NGR-36-010-024)
(NASA-TM-X-71726) Avail NTIS HC $6 25 CSCL 01D

The control of an airbreathing turbojet engine by an onboard digital computer is studied The approach taken is to model the turbojet engine as a linear multivariable system whose parameters vary with engine operating environment From this model adaptive closed-loop or feedback control laws are designed and applied to the acceleration of the turbojet engine Author

N75-23574# National Gas Turbine Establishment Pyestock (England)
THRUST/DRAG ANALYSIS FOR A FRONT FAN NACELLE HAVING TWO SEPARATE CO-AXIAL EXHAUST STREAMS
P G Street 1975 38 p refs Supersedes NGTE-321 ARC-34645
(ARC-CP-1311 NGTE-321 ARC-34645) Avail NTIS HC $3 75, HMSO 90p PHI $4 10

The forces acting on and around a high by-pass ratio front fan nacelle are considered in terms of the findings of an ARC panel on thrust and drag definitions for jet engines Thrust and drag components which take account of mutual interference are defined A technique for defining an afterbody or gas generator cowl drag in the presence of external flow is derived and the experimental measurements required are listed Example calculations using experimental data are used to demonstrate the technique   Author

N75-23575# Advisory Group for Aerospace Research and Development Paris (France)
POWER PLANT CONTROLS FOR AERO-GAS TURBINE ENGINES
Mar 1975 374 p refs In ENGLISH partly in FRENCH Presented at the 44th Meeting of the AGARD Propulsion and Energetics Panel Ustaoset Norway 9-13 Sep 1974
(AGARD-CP-151) Avail NTIS HC $10 00
    Control requirements control simulation techniques and control system hardware for improved reliability of aircraft gas turbine engines are elaborated

N75-23577 Centre d Essais de Propulseurs Saclay (France)
CONTRIBUTION OF FLIGHT SIMULATION TESTS TO THE STUDY OF TURBOMACHINE CONTROL [CONTRIBUTION DES ESSAIS EN VOL SIMULE A L'ETUDE DE LA REGULATION DES TURBOMACHINES]
Vincent Nardone and Jean Claude Ripoll In AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 9 p refs In FRENCH
    Flight simulation tests and their use to develop controls for turbine engines under various flight conditions are discussed Tests examined the effects of pressure static pressure build up, and temperature at various Mach numbers Engine response and control during the transition phase were also studied
                                                                      Transl by E H W

N75-23578 Boeing Commercial Airplane Co, Renton Wash Propulsion Technology Controls Group
AN AIRFRAME MANUFACTURER'S REQUIREMENTS FOR FUTURE PROPULSION CONTROLS
Peter W Kamber In AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 17 p refs

    Selective allocation of service bleed is presented as a means of extending engine life for a mix of nominal and deteriorating engines while preserving a desired thrust distribution Rating command control is examined as a means to permit simple and definitive power setting where each power rating is uniquely associated with a pushbutton or throttle position Hydromechanical and electronic control systems are compared and it is reported that electronics will be used for most advanced control modes Electronic engine controls are also presented as the foundation for improved coordination with flight controls and for on-line engine condition monitors   Author

N75-23579 Rolls-Royce Ltd Derby (England)
CONTROL SYSTEM REQUIREMENTS DICTATED BY OPTIMIZATION OF ENGINE OPERATION
Christopher Linley Johnson In AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 5 p

    A pneumatic mechanical flat rating system is included in the RB 211 control system and the reason for the choice of parameters on which this operates is discussed On this system the pilot sets up the engine rating and the control then maintains it through variations of temperature and altitude   Author

N75-23581 Ministry of Defence London (England)
RELIABILITY SPECIFICATION FOR GAS TURBINE CONTROL SYSTEMS
C G White In AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 9 p refs

Reliability is a procurement requirement like any other parameter such as cost, response or program time scale The problems peculiar to engine control systems are examined and some suggestions made The problems of specifying reliability parameters are reviewed and methods of reliability assurance and measurement are described   Author

N75-23582 Air Force Aero Propulsion Lab Wright-Patterson AFB Ohio
THE ROLE OF COMPUTERS IN FUTURE PROPULSION CONTROLS
Charles E Bentz In AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 9 p refs

    The role of computers in future propulsion controls is reviewed from two different viewpoints - the integrated avionics approach and the dedicated propulsion system approach The discussion presented suggests that a dedicated computer for the propulsion system control will provide a more optimum solution in the future in terms of cost complexity and reliability An integrated avionic systems approach that also includes the propulsion system control poses many new problems in the areas of system management and hardware development that may overshadow any of the immediate benefits of using a central processor
                                                                      Author

N75-23583 Pratt and Whitney Aircraft East Hartford Conn
CONTROL DESIGN CONSIDERATIONS FOR VARIABLE GEOMETRY ENGINES
W K Tervo and J M Tringali In AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 8 p refs

    Variable cycle engine control requirements are described Control variables and potential sensed parameters are discussed The complexity of the job is shown to require optimal control logic An application of optimal control techniques is presented including simulation results   Author

N75-23584 Motoren- und Turbinen-Union Muenchen G m b H (West Germany)
PRAC A NEW AERO GAS TURBINE ENGINE CONTROL CONCEPT
K Bauerfeind In AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 14 p

    The Pressure Ratio Acceleration Control (PRAC) offers a new approach to the control of modern aero gas turbine engines With the exception of the use of high accuracy pressure transducers mounted in a temperature controlled box directly on the engine all other system components are of today s standard of technology A simple bread board model of PRAC had been built and successfully tested in conjunction with an Orpheus jet engine in a high altitude test facility A more sophisticated PRAC control system for a modern supersonic bypass engine is being tested at present in conjunction with an engine simulator and the actual fuel system hardware on a control system rig at MTU The paper outlines the control philosophy of PRAC and presents test results achieved so far   Author

N75-23585 Rolls-Royce Ltd Watford (England) Small Engine Div
HELICOPTER ENGINE CONTROL THE PAST 20 YEARS AND THE NEXT
Edward A Simonis and Malcolm P Perks In AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 16 p

    The first 20 years of gas turbine application to helicopters and the progressive evolution of their associated fully automatic engine control systems are surveyed It is only recently that the dominant performance and safety requirements of the control have emerged with sufficient clarity to allow them to be viewed by an overall systems engineering approach instead of as piecemeal needs A system is outlined which offers substantial reductions in size and weight over current systems without any sacrifice in performance or safety and with marked improvement in integrity The utilization of digital control techniques leads to

simple handling from the cockpit with self monitoring facilities and unambiguous reversionary control modes Such a system is seen as setting a pattern for control of helicopter engines of the future   Author

N75-23586 National Gas Turbine Establishment Farnborough (England)
A DIGITAL CONTROLLER APPLIED TO THE LIMITATION OF REHEAT COMBUSTION ROUGHNESS
J H Waters *In* AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 8 p ref

Reheat combustion roughness or buzz could cause damaging fluctuations in jet pipe pressure in high performance reheat combustion systems A control scheme is described which controls reheat fuel flow so as to limit the level of jet pipe pressure fluctuations to safe values Factors which affect the design and implementation of the controller are discussed and an indication given of its performance   Author

N75-23587 Dowty Fuel Systems Ltd Cheltenham (England)
AFTERBURNING REGULATION CONCEPTS
K Robinson *In* AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 17 p

Various concepts of afterburner flow regulation are examined with particular reference to bypass type engines requiring rapid thrust modulation with minimum disturbance to engine operating conditions Logic and sequencing functions associated with selection of afterburner operation are examined Afterburner system organization is discussed briefly and the merits and short comings of alternative concepts are argued   Author

N75-23589 Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany)
AN AIR INTAKE CONTROL SYSTEM FOR A SUPERSONIC FIGHTER AIRCRAFT
J Peikert *In* AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 5 p
A description of an air intake system of the two dimensional external compression type and its associated air intake control system is given The AICS comprises a wedge control only Intake operating maps derived from small scale wind tunnel test results are shown and the resulting selection of control signals and the control concept is presented The performance of the intake and the AICS is substantiated by full scale wind tunnel test results Finally the hardware implementation of the AICS from a system standpoint is also given   Author

N75-23592 National Research Council of Canada Ottawa (Ontario) Engine Lab
EQUILIBRIUM PERFORMANCE ANALYSIS OF GAS TURBINE ENGINES USING INFLUENCE COEFFICIENT TECHNIQUES
E P Cockshutt *In* AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 10 p refs

Starting from a specified engine design point, a computer oriented technique is described for establishing the equilibrium off-design performance The technique involves the control system approach of linearizing the governing equations at the design point, in order to establish a matrix of engine response influence coefficients These coefficients are then used to achieve rapid convergence as the cycle iterates to an off-design operating point For clarity of presentation the technique is developed for the simple turbojet cycle but the extrapolation to turbofan cycles is indicated By way of illustrative example of the equilibrium analysis technique, attention is given to the temporary extraction of large amounts of air bleed from a turbofan for applications such as flap blowing and reaction controls Engine response to this perturbation is assessed and control implications suggested   Author

N75-23593* National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

GENERALIZED DYNAMIC ENGINE SIMULATION TECHNIQUES FOR THE DIGITAL COMPUTERS
James Sellers and Fred Teren *In* AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 23 p refs

Recently advanced simulation techniques have been developed for the digital computer and used as the basis for development of a generalized dynamic engine simulation computer program called DYNGEN This computer program can analyze the steady state and dynamic performance of many kinds of aircraft gas turbine engines Without changes to the basic program DYNGEN can analyze one- or two-spool turbofan engines The user must supply appropriate component performance maps and design point information Examples are presented to illustrate the capabilities of DYNGEN in the steady state and dynamic modes of operation The analytical techniques used in DYNGEN are briefly discussed and its accuracy is compared with a comparable simulation using the hybrid computer The impact of DYNGEN and similar digital programs on future engine simulation philosophy is also discussed   Author

N75-23594 National Gas Turbine Establishment Farnborough (England)
TOTAL POWERPLANT SIMULATION
R V Cottington *In* AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 24 p refs

The capability of predicting the steady state performance of a gas turbine engine is extended to include the prediction of its transient behavior as well The development and implementation of a total powerplant simulation consisting of intake and engine that is capable of predicting both steady state and transient performance are described The simulation is based on the synthesis of the thermodynamic relationships describing each powerplant component During the development stage digital simulation techniques are used although the simulation is finally implemented on a hybrid computer in order to achieve real time operation Actual steady state and transient test bed results are then used when available to validate the simulation   Author

N75-23595 Lucas Aerospace Ltd Birmingham (England)
USE OF SIMULATION IN THE DESIGN, DEVELOPMENT AND TESTING OF POWER PLANT CONTROL SYSTEMS
Stephan Nye and Robert J Vickers *In* AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 13 p

The design, development and testing of an engine control system are discussed Two specific areas are highlighted (1) Digital simulation using large scale computers where both engine and control system are represented by mathematical models for evaluation feasibility and tolerance analysis and (2) hybrid computers where a real time digital engine simulation is used in conjunction with a speed controlled rig for real time development of the control hardware   Author

N75-23596 Lucas Aerospace Ltd Birmingham (England)
THE USE OF DIGITAL CONTROL FOR COMPLEX POWER PLANT MANAGEMENT
D M Griffiths and R D Powell *In* AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 26 p refs

The application of digital control techniques to complex power plants is considered by describing the general structure of a digital controller in regard to system requirements A description is then provided of an engineered controller The characteristics of the unit are given together with details of its construction software reliability and integrity targets From this experience reasonable conclusions can be drawn with respect to its area of application and of the likely future for digital techniques   Author

N75-23597 International Harvester Co San Diego Calif Solar Div
TEMPERATURE MEASUREMENT FOR ADVANCED GAS TURBINE CONTROLS
David A Rohy, T E Duffy, and W A Compton *In* AGARD

Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 27 p refs

Modern gas turbine engines with turbine inlet temperatures higher than metal melting temperatures must have control systems which provide subsecond response to changes in gas or metal temperatures High quality data are required to provide for the most efficient engine operation consistent with engine safety Recently developed instruments measure individual blade temperature and another non-immersion gas temperature sensor not yet fully developed will provide accurate gas temperature data up to 1927 C These instruments are described with present and potential uses in control systems   Author

N75-23598 Pisa Univ (Italy)
FLUIDIC SENSORS FOR TURBOJET ENGINES
D Dini and M Santochi In AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 28 p refs

Fluidics may replace electronics in modern advanced turbojet engine instrumentation technology for comprehensive engine condition monitoring in highly unfavourable environments This paper discusses some fluidic sensors originally tested in our laboratory (1) new types of rotational speed sensors utilizing air flows output being a pressure signal proportional to the value to be measured suitable for analog and digital circuits and (2) gas stream temperature sensors using a thermometric bulb or a bimetallic spring or a capillary tube or a turbulent jet Corresponding experimental results are summarized and completely fluidic circuits for a small gas turbine and for fire detection in a turbojet engine are described   Author

N75-23599 Pierburg Luftfahrtgeraete Union G m b H Neuss (West Germany)
A NEW LIGHTWEIGHT FUEL CONTROL SYSTEM FOR ELECTRICAL INPUTS
Heinz Holzem In AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 30 p refs

Most modern control concepts for complex aero gas turbine engines employ more and more electronic hardware for the function generating part It was therefore necessary to define the requirements for a simple lightweight fuel metering system basically consisting of a pumping device manifolds filters and an electrically controlled metering value controlled by the electronic box Such a system has been specified and is being built and developed at present This fuel system will be used in conjunction with the PRAC electronic control The paper describes this system and highlights critical design and development areas   Author

N75-23600 Dowty Fuel Systems Ltd Cheltenham (England)
PUMPING SYSTEM DESIGN RELATED TO FUEL SYSTEM SPECIFICATIONS
A T Miles In AGARD Power Plant Controls for Aero-Gas Turbine Eng Mar 1975 32 p

Design of the pump in its context the fuel system is discussed System requirements are related to pump limitations So varied are the requirements that the pumps have to be specifically designed for the system Discussion first centers on optimizing low pressure systems to minimize heat rejection to the fuel The concepts of net positive suction head and vapor liquid ratio are contrasted in the context of cavitation Description of two phase flow regimes leads to particular focus on the engine driven backing pump Design philosophy to cope with contaminated fuel is followed by an analysis of turn down heat to fuel problems as they affect the high pressure dry engine pump and the afterburner pump The large afterburner turn down flow ratio justifies the vapor core pump design and its principle of operation is outlined   Author

N75-23601 Colt Industries Inc West Hartford Conn
ADVANCED ENGINE MOUNTED FUEL PUMP TECHNOLOGY
John E Cygnor In AGARD Power Plant Controls for Aero-Gas

Turbine Eng Mar 1975 33 p

Based upon the flight envelope of a typical high performance aircraft the relationship between the efficiency of engine mounted fuel pumps at high fuel flow turndown ratios and the fuel heat sink available to the engine and airframe is discussed The effect of the pump efficiency on the fuel heat sink is presented in terms of the temperature rise imparted to the fuel by the pump and fuel flow metering system The sources of losses of conventional fuel pump and metering systems which contribute to the fuel temperature rise are identified and pump and metering systems which will reduce those losses are discussed Examples of pump types which are applicable to advanced turbine engines are presented in terms of performance parameters and system advantages   Author

N75-23602*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
TRANSONIC OFF-DESIGN DRAG AND PERFORMANCE OF THREE MIXED-COMPRESSION AXISYMMETRIC INLETS
Richard R Woollett Edward T Meleason and David A Choby Washington Jun 1975 50 p refs
(NASA-TM-X-3215 E-8146) Avail NTIS HC $3 75 CSCL 21A

An experimental investigation was conducted to determine the off-design drag and pressure performance of three axisymmetric supersonic inlets in the transonic speed range For typical engine airflows at Mach 0 8 the drag coefficient varied from 0 045 to 0 09 at Mach 1 2 the largest drag coefficient measured was 0 25 Below Mach 0 9 a lower drag resulted when all or at least part of the excess weight flow was spilled over the cowl rather than through the bypass doors above Mach 1 1 the lowest drag was obtained by bypassing excess flow Author

N75-23603# Air Force Aero Propulsion Lab Wright-Patterson AFB Ohio
HIGH TEMPERATURE TESTS OF A JP-5 TYPE FUEL Final Report, 20 Sep - 15 Nov 1972
Warren Bucher and Royce Bradley Jan 1975 31 p refs
(AF Proj 3048)
(AD-A007662 AFAPL-TR-74-74) Avail NTIS CSCL 21/4

Tests were performed to determine the thermal stability of a JP-5 jet fuel with varying concentrations of dissolved oxygen under supercritical pressure and temperature conditions Tests were done with the Advanced Aircraft Fuel Systems Simulator using a simulated engine manifold Small unintentional variations in the test pressure caused large changes in deposit formation rate These variations obscured any effects of dissolved oxygen The results indicate that tests to determine the effects of dissolved oxygen on thermal stability of jet fuel at supercritical conditions will have to be run with carefully controlled test pressures
GRA

N75-23604# Exxon Research and Engineering Co Linden N J Government Research Lab
DEVELOPMENT OF HIGH STABILITY FUEL Final Report, 1 Jul - 31 Dec 1974
William F Taylor and John W Grankenfeld Jan 1975 123 p refs
(Contract N00140-74-C-0618)
(AD-A007574 GRU 13 GAHF 75) Avail NTIS CSCL 21/4

The study of oxygenated trace impurities on the stability of Humble JP-5 was extended to include a typical aliphatic-aromatic ester (methyl benzoate) an aliphatic ester (phenyl formate) an aliphatic alcohol (n-dodecyl alcohol) and a ketone (5-nonanone) All were evaluated in deoxygenated Humble JP-5 at the 100 PPM 0 level Hexanoic was also investigated Six new diolefins were evaluated in a deoxygenated synthetic 4-component blend This blend consisted of 25% (by weight) of n-dodecane 25% of 2 2 5-trimethylhexane 30% of isopropylcyclohexane and 20% of secbutylbenzene The results confirm the previous observations that structural features play an important part in determining the influence of olefins on deposit formation A representative substituted acetylene 1-decyne was also tested in the 4-component synthetic blend Two condensed ring hydrocarbons indan and tetralin were tested in a new 4-component blend Scanning electron microscope studies of deposit morphology were extended

to pure hydrocarbon blends containing various amounts of dissolved oxygen A survey of the use of acid washing caustic washing and absorbents in refining of jet fuel was conducted to determine the possible changes in trace impurity content brought about by such processing steps GRA

N75-23605# Air Force Aero Propulsion Lab Wright-Patterson AFB Ohio
PRACTICAL STABILITY OF A RELUCTANCE SYNCHRO-NOUS MACHINE Final Report, Oct 1973 - Mar 1974
William U Borger Feb 1975 81 p refs
(AF Proj 3145)
(AD-A007659 AFAPL-TR-74-118) Avail NTIS CSCL 09/3
The ideal reluctance synchronous machine with dual rotor windings is modeled mathematically and simulated on a digital computer In addition it is demonstrated that practical stability of the machine exists when the Liapunov theorem requirements have been met GRA

N75-23606*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
A FORMAL STRUCTURE FOR ADVANCED AUTOMATIC FLIGHT-CONTROL SYSTEMS
George Meyer and Luigi Cicolani Washington May 1975 39 p refs
(NASA-TN-D-7940 A-5710) Avail NTIS HC $3 75 CSCL 01D
Techniques were developed for the unified design of multimode variable authority automatic flight-control systems for powered-lift STOL and VTOL aircraft A structure for such systems is developed to deal with the strong nonlinearities inherent in this class of aircraft to admit automatic coupling with advanced air traffic control and to admit a variety of active control tasks The aircraft being considered is the augmentor wing jet STOL research aircraft Author

N75-23607# Cranfield Inst of Technology (England) Flight Div
THE INFLUENCE OF SHORT SPRINGS ON LONGITUDINAL STATIC STABILITY
M E Eshelby Mar 1975 41 p refs
(Cranfield-Aero-29) Avail NTIS HC $3 75
The theory of springs as stability augmentors is discussed and comparison made between ideal long springs and the short springs more commonly found in light aircraft Data and information from recent flight development trails are analysed to provide a practical demonstration of the effects produced Author

N75-23608# Cornell Univ Ithaca N Y Sibley School of Mechanical and Aerospace Engineering
RESEARCH ON HELICOPTER ROTOR NOISE Final Report, 2 Oct 1973 - 31 Dec 1974
A R George 10 Feb 1975 17 p refs
(Contract DAHC04-74-C-0001)
(AD-A007261 ARO-9372-6-E) Avail NTIS CSCL 01/3
During the period of this contract research was carried out on three main aspects of helicopter rotor noise These were the prediction of broadband noise due to random loadings high speed blade noise and noise due to the acceleration of solid bodies The noise due to the acceleration of solid bodies was investigated experimentally and compared to calculations based on Farassat s results The final results show excellent agreement between theory and experiment and a paper has been submitted to the Journal of Sound and Vibration reporting this work GRA

N75-23611*# Massachusetts Inst of Tech Cambridge Fluid Dynamics Research Lab
THE DEVELOPMENT OF EXPERIMENTAL TECHNIQUES FOR THE STUDY OF HELICOPTER ROTOR NOISE Final Report, Jun 1973 - Nov 1974
Sheila E Widnall, Wesley L Harris, Ying-Chieh Albert Lee and Herman M Drees Nov 1974 89 p refs Sponsored in part by Army Air Mobility R and D Lab, Moffett Field Calif
(Contract NAS2-7684)
(NASA-CR-137684) Avail NTIS HC $4 75 CSCL 14B

The features of existing wind tunnels involved in noise studies are discussed The acoustic characteristics of the MIT low noise open jet wind tunnel are obtained by employing calibration techniques one technique is to measure the decay of sound pressure with distance in the far field the other technique is to utilize a speaker which was calibrated as a sound source The sound pressure level versus frequency was obtained in the wind tunnel chamber and compared with the corresponding calibrated values Fiberglas board-block units were installed on the chamber interior The free field was increased significantly after this treatment and the chamber, cut-off frequency was reduced to 160 Hz from the originally designed 250 Hz The flow field characteristics of the rotor-tunnel configuration were studied by using flow visualization techniques The influence of open-jet shear layer on the sound transmission was studied by using an Aeolian tone as the sound source A dynamometer system was designed to measure the steady and low harmonics of the rotor thrust A theoretical Mach number scaling formula was developed to scale the rotational noise and blade slap noise data of model rotors to full scale helicopter rotors Author

N75-23617# General Dynamics/Fort Worth Tex
AIRCRAFT ENGINE NACELLE FIRE TEST SIMULATOR Final Report, 1 Apr - 1 Dec 1974
R J Springer Dec 1974 237 p refs
(Contract F33615-74-C-2035 AF Proj 3048)
(AD A007853 AFAPL-TR-74-101) Avail NTIS CSCL 01/3
The objective of this program was to develop design rationale test criteria and complete detail design of an aircraft engine nacelle fire test simulator The fabrication of a simulator from the detail design of this program will allow a more realistic investigation of engine nacelle fire problems and the evaluation of fire prevention hardware detection and extinguishment systems generated by aircraft programs The fabrication of the simulator was not a part of this program This report documents the steps taken in defining the simulator design goals and require-ments conducting of preliminary design trade-off studies the selection of a final simulator configuration and detail design of this simulator GRA

N75-23709 Messerschmitt-Boelkow G m b H Ottobrunn (West Germany)
DESIGN OF COMPOSITE STRUCTURE WITH RESPECT TO AVOID CRACK PROPAGATION
K Brunsche In AGARD Specialists Meeting on Failure Modes of Composite Mater With Organic Matrices and Their Conse-quences on Design Mar 1975 9 p ref

Within the manifold of composite structures developed rotary wings are the best known components Several types of composite rotorblades have been developed tested and produced The experience with fatigue testing many GFP CFP and mixed modulus coupons and full scale blade sections is used to make some design recommendation how crack propagation might be avoided Respect is given to both influence of fabrication and influence of environment For some cases deformation limits up to which no damage propagation occurs are given Author

N75-23775# Reynolds Metals Co Richmond Va Metallurgical Research Div
PROGRAM TO IMPROVE THE FRACTURE TOUGHNESS AND FATIGUE RESISTANCE OF ALUMINUM SHEET AND PLATE FOR AIRCRAFT APPLICATIONS, VOLUME 2 Final Report, 1 Mar - 1 Jul 1974
David S Thompson and Robert E Zinkham Sep 1974 82 p refs
(Contract F33615-74-C-5060 AF Proj 7351)
(AD-A003417 AFML-TR-73-247-Vol-2) Avail NTIS CSCL 11/6
The fatigue crack growth rate (FCGR) characteristics of a 7000 series and a 2000 series alloy were evaluated The bulk of the work was carried out on thermomechanically aged (TMA) RX725 (Al-6Zn-2 5Mg-1 5Cu- 1 Zr) and 2048 in the TMA and -T3E9 tempers respectively Crack growth rate was reduced by

either crack branching or deviation of the crack from the plane normal to the applied stress Both experimental materials were found to be sensitive to environment (high or low humidity) even though they were resistant to exfoliation corrosion An inverse hyperbolic tangent model fitted the data well, but the parameters in the model did not lend themselves to characterizing FCGR material performance It was concluded that significant benefits could be achieved by TMA processing   GRA

N75-23885*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
SUBSCALE, HYDROGEN-BURNING, AIRFRAME-INTEGRATED-SCRAMJET EXPERIMENTAL AND THEO-RETICAL EVALUATION OF A WATER COOLED STRUT AIRFRAME-INTEGRATED-SCRAMJET EXPERIMENTAL LEADING EDGE
S Z Pinckney R W Guy H L Beach and R C Rogers May 1975 43 p refs
(NASA-TM-X-72682) Avail NTIS HC $3 75 CSCL 01C
A water-cooled leading-edge design for an engine/airframe integrated scramjet model strut leading edge was evaluated The cooling design employs a copper cooling tube brazed just downstream of the leading edge of a wedge-shaped strut which is constructed of oxygen-free copper The survival of the strut leading edge during a series of tests at stagnation point heating rates confirms the practicality of the cooling design A finite difference thermal model of the strut was also proven valid by the reasonable agreement of calculated and measured values of surface temperature and cooling-water heat transfer   Author

N75-23906# Air Force Systems Command Wright-Patterson AFB Ohio   Foreign Technology Div
NATURAL OSCILLATIONS OF LIQUID IN A HORIZONTAL CONTAINER WITH SYMMETRIC DOUBLE-CONNECTED CROSS SECTION
I V Kolin 24 Jan 1975 17 p refs Transl into ENGLISH from Tsentr Aerogidrodinamicheskii Inst Uch Zap (USSR) v 2 no 3 1971 p 117-120
(AD-A007312 FTD-MT-24-0582-75) Avail NTIS CSCL 20/4
The approximate differential equations were obtained for determining natural vibration frequencies of liquid and coordinates of the points of application of flow forces Calculation results are compared with experimental results Other topics discussed include computer techniques digital computers stability analysis and disturbed motion of winged flight vehicles   MJS

N75-23946# United Aircraft Corp East Hartford Conn Research Labs
NONDESTRUCTIVE HOLOGRAPHIC TECHNIQUES FOR STRUCTURES INSPECTION Final Report, 1 Jul 1971 - 30 Apr 1974
Robert K Erf Ronald M Gagosz James P Waters Karl A Stetson and Herbert G Aas Oct 1974 181 p refs
(Contract F33615-71-C-1874 AF Proj 7351)
(AD-A007850 UARL-N991208-36 AFML-TR-74-130) Avail NTIS CSCL 14/2
The theoretical and experimental work performed during a three year study concerned with a research investigation of nondestructive holographic techniques for structures inspection are reviewed Topics discussed include the following General studies - physical environment effects General studies - surface finish effects General studies - develop suitable techniques for a manufacturing or maintenance environment Specific problem investigations - maximum strain and strain patterns Specific problem investigations - fatigue cracks Specific problem investigations - NDT   GRA

N75-24031# Technion - Israel Inst of Tech Haifa   Dept of Aeronautical Engineering
FATIGUE PROPERTIES OF AIRCRAFT LUGS WITH INTERFERENCE FIT
Alfred Buch Feb 1975 62 p refs
(TAE-243) Avail NTIS HC $4 25 CSCL 13E

Fatigue tests were carried out on aluminum alloy lugs with different hole diameters and configurations A strong improvement in fatigue properties was observed in cases of relative intereference fits larger than 0 2% The effect of the stresses produced by the interference fit were theoretically analyzed and the critical stress level below which the interference fit has a beneficial effect was determined A method for evaluation of the fatigue life of interference-fit aluminum lugs is proposed   Author

N75-24032*# Boeing Aerospace Co Seattle, Wash
DESIGN AND FABRICATION OF RENE 41 ADVANCED STRUCTURAL PANELS
Bruce E Greene and Russell F Northrup [1975] 59 p refs
(Contract NAS1-10749)
(NASA-CR-132646) Avail NTIS HC $4 25 CSCL 13M
The efficiency was investigated of curved elements in the design of lightweight structural panels under combined loads of axial compression inplane shear and bending The application is described of technology generated in the initial aluminum program to the design and fabrication of Rene 41 panels for subsequent performance tests at elevated temperature Optimum designs for two panel configurations are presented The designs are applicable to hypersonic airplane wing structure and are designed specifically for testing at elevated temperature in the hypersonic wing test structure located at the NASA Flight Research Center Fabrication methods developed to produce the Rene panels are described and test results of smaller structural element specimens are presented to verify the design and fabrication methods used Predicted strengths of the panels under several proposed elevated temperature test load conditions are presented   Author

N75-24044# Air Force Systems Command, Wright-Patterson AFB, Ohio   Foreign Technology Div
STRESS CONCENTRATION IN AN EXPANDED PLATE WITH OPENING REINFORCED BY CENTRAL BELT
V I Grishin 28 Jan 1975 22 p refs Transl into ENGLISH from Uch Zap Tsentr Aerogidrodinamicheskii Inst (USSR) v 3, no 6 1972 p 101-106
(AD-A007672 FTD-MT-24-0521-75) Avail NTIS CSCL 20/11
The finite element method was used to determine stress concentration in a plate with grooves The objective was to determine the effect of proximity of the stringer to opening/aperture on stress concentration in the expanded plate   Author

N75-24186# Informatics Inc Rockville Md
CIVIL AVIATION STUDIES AND INTERAGENCY COORDI-NATING ORGANIZATIONS, VOLUME 1
Carl Modig Dec 1974 165 p refs 2 Vol
(Contract EPA-68-01-2229)
(PB-239344/5 EPA-550/9-74-019A-Vol-1) Avail NTIS HC $6 25 CSCL 01C
Federal organizations set up to coordinate civil aviation policy are described including those dealing with the aircraft noise problem and commissions and agency task groups who studied civil aviation problems The evolution of these organizations from after World War II to the present is traced It is concluded that (1) in the early 1960 s there was no institution actively coordinating federal aircraft noise abatement activities (2) much of the impetus for better coordination has come from Congress (3) successful coordination requires high-level agency and Administration support (4) the host agency may have difficulty securing cooperation of other agencies   GRA

N75-24187# Informatics Inc Rockville Md
CIVIL AVIATION STUDIES AND INTERAGENCY COORDI-NATING ORGANIZATIONS, VOLUME 2 APPENDICES
Carl Modig Dec 1974 180 p refs 2 Vol
(Contract EPA-550/9-74-019B)
(PB-239345/2 EPA-550/9-74-019B-Vol-2) Avail NTIS HC $7 00 CSCL 01C
Source documents are reproduced in whole or in part to provide more detailed information on various federal organizations set up to coordinate or study civil aviation policy including those dealing with the aircraft noise problem   GRA

N75-24192# ARO Inc Arnold Air Force Station Tenn
DROPLET DIAMETER AND SIZE DISTRIBUTION OF JP-4 FUEL INJECTED INTO A SUBSONIC AIRSTREAM Final Report, 22 Oct - 12 Dec 1973
R A Wasson Jr C R Darlington and J C Billingsley AEDC
Apr 1975 43 p refs
(AD-A007687 ARO-ETF-TR-74-92 AEDC-TR-74-117) Avail NTIS CSCL 21/4

A test program was conducted to determine the size and distribution of JP-4 fuel droplets when fuel was dispersed at a constant fuel nozzle exit velocity into a subsonic airstream Testing was conducted at free-stream flight velocities ranging from 200 to 400 knots at altitudes ranging from 12 000 to 25 000 feet with flow rates of approximately 13 75 and 290 1bm/min Holograms of the fuel droplets were taken 18 feet downstream of the fuel nozzle exit plane Representative histograms of fuel droplet size distribution and average fuel droplet diameter are presented Average fuel droplet diameter was not significantly affected by any of the test variables All arithmetic average fuel droplet diameter data were within a 19 to 36-micrometer band
GRA

N75-24436# Wiggins (J H) Co Redondo Beach Calif
SOUND AND VIBRATION MEASUREMENTS FOR CONCORDE SUPERSONIC TRANSPORT AND SUBSONIC JET AIRCRAFT Final Report, Jan - Jul 1974
John H Wiggins 31 Jul 1974 118 p refs
(Contract DOT-OS-40121)
(PB-238748/8 DOT-TST-75-21) Avail NTIS HC $5 25 CSCL 20A

Sound and structural vibration levels resulting from operations of both supersonic (SST) and conventional subsonic jet aircraft are analyzed The study first analyzes the potential differences in noisiness between SST and conventional aircraft knowing only the sound pressure spectra Next results of monitored SST and conventional aircraft flights conducted at Fairbanks Alaska International Airport on February 11-15 1974 are reported These results test the hypothesis put forth in the analytical portion of the report
GRA

N75-24654*# National Aeronautics and Space Administration Washington D C
KOROLEV A CHRONICLE
Yaroslav Golovanov Apr 1975 231 p refs Transl into ENGLISH from the book Korolev Khronika Moscow Molodaya Gvardiya 1973 p 1-254
(NASA-TT-F-16278) Avail NTIS HC $7 50 CSCL 05B

A partial biography of Sergey Pavlovich Korolev is presented which covers his life from birth to the age of 28 A history of the development of Soviet space and rocket technology during those 28 years is also included
MJS

N75-24671* National Aeronautics and Space Administration Ames Research Center Moffett Field, Calif
LARGE-SCALE WIND-TUNNEL TESTS OF THREE VEHICLES INCORPORATING A DEPLOYABLE RIGID WING
Terrell W Feistel and Ralph L Maki Aug 1974 64 p ref
(NASA-TM-X-62405 A-5854) Avail NTIS HC $4 25 CSCL 01B

Wind-tunnel tests were performed to determine the aerodynamic characteristics of three full-scale vehicles incorporating a unique folding metal wing, and to investigate its deployment characteristics The static aerodynamic data are presented without analysis
Author

N75-24672*# Boeing Co, Renton, Wash
PREDICTION OF UNSTEADY AERODYNAMIC LOADINGS CAUSED BY LEADING EDGE AND TRAILING EDGE CONTROL SURFACE MOTIONS IN SUBSONIC COMPRESSIBLE FLOW COMPUTER PROGRAM DESCRIPTION
M C Redman and W S Rowe May 1975 157 p refs
(Contract NAS1-12020)
(NASA-CR-132634) Avail NTIS HC $6 25 CSCL 20K

A digital computer program has been developed to calculate unsteady loadings caused by motions of lifting surfaces with leading edge or trailing edge controls based on the subsonic kernel function approach The pressure singularities at hinge line and side edges have been extracted analytically as a preliminary step to solving the integral equation by collocation The program calculates generalized aerodynamic forces for user supplied deflection modes Optional intermediate output includes pressure at an array of points, and sectional generalized forces From one to six controls on the half span can be accommodated
Author

N75-24673*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
ANALYSIS OF VARIOUS DESCENT TRAJECTORIES FOR A HYPERSONIC-CRUISE, COLD-WALL RESEARCH AIRPLANE
Pierce L Lawing Washington Jun 1975 62 p refs
(NASA-TN-D-7860, L-9778) Avail NTIS HC $4 25 CSCL 01A

The probable descent operating conditions for a hypersonic air-breathing research airplane were examined Descents selected were cruise angle of attack high dynamic pressure, high lift coefficient turns and descents with drag brakes The descents were parametrically exercised and compared from the standpoint of cold-wall (367 K) aircraft heat load The descent parameters compared were total heat load, peak heating rate, time to landing time to end of heat pulse and range Trends in total heat load as a function of cruise Mach number cruise dynamic pressure angle-of-attack limitation pull-up g-load heading angle, and drag-brake size are presented
Author

N75-24674*# Aerophysics Research Corp Bellevue Wash
AN INVESTIGATION ON THE EFFECT OF SECOND-ORDER ADDITIONAL THICKNESS DISTRIBUTIONS TO THE UPPER SURFACE OF AN NACA 64 SUB 1-212 AIRFOIL
Donald S Hague and Antony W Merz Jan 1975 47 p refs
Supercedes TN-194
(Contract NAS2-8599)
(NASA-CR-137701 TN-194) Avail NTIS HC $3 75 CSCL 01C

An investigation was conducted on a CDC 7600 digital computer to determine the effects of additional thickness distributions to the upper surface of an NACA 64 sub 1 - 212 airfoil Additional thickness distributions employed were in the form of two second-order polynomial arcs which have a specified thickness at a given chordwise location The forward arc disappears at the airfoil leading edge the aft arc disappears at the airfoil trailing edge At the juncture of the two arcs $x = x$, continuity of slope is maintained The effect of varying the maximum additional thickness and its chordwise location on airfoil lift coefficient pitching moment, and pressure distribution was investigated Results were obtained at a Mach number of 0 2 with an angle-of-attack of 6 degrees on the basic NACA 64 sub 1 - 212 airfoil, and all calculations employ the full potential flow equations for two dimensional flow The relaxation method of Jameson was employed for solution of the potential flow equations
Author

N75-24675*# Aerophysics Research Corp Bellevue, Wash
AN INVESTIGATION ON THE EFFECT OF SECOND-ORDER ADDITIONAL THICKNESS DISTRIBUTIONS TO THE UPPER SURFACE OF AN NACA 64-206 AIRFOIL
Antony W Merz and Donald S Hague Feb 1975 32 p refs
Supercedes TN-195
(Contract NAS2-8599)
(NASA-CR-137702 TN-195) Avail NTIS HC $3 75 CSCL 01C

An investigation was conducted on a CDC 7600 digital computer to determine the effects of additional thickness distributions to the upper surface of an NACA 64-206 airfoil Additional thickness distributions employed were in the form of two second-order polynomial arcs which have a specified thickness at a given chordwise location The forward arc disappears at the airfoil leading edge the aft arc disappears at the airfoil trailing edge At the juncture of the two arcs $x = x$ continuity

of slope is maintained The effect of varying the maximum additional thickness and its chordwise location on airfoil lift coefficient pitching moment and pressure distribution was investigated Results were obtained at a Mach number of 0 2 with an angle-of-attack of 6 degrees on the basic NACA 64-206 airfoil, and all calculations employ the full potential flow equations for two dimensional flow The relaxation method of Jameson was employed for solution of the potential flow equations

Author

N75-24676*# Aerophysics Research Corp Bellevue Wash
THEORETICAL EFFECT OF MODIFICATIONS TO THE UPPER SURFACE OF TWO NACA AIRFOILS USING SMOOTH POLYNOMIAL ADDITIONAL THICKNESS DISTRIBUTIONS WHICH EMPHASIZE LEADING EDGE PROFILE AND WHICH VARY QUADRATICALLY AT THE TRAILING EDGE
Anthony W Merz and Donald S Hague Mar 1975 40 p refs Supersedes TN-199
(Contract NAS2-8599)
(NASA-CR-137703 TN-199) Avail NTIS HC $3 75 CSCL 01C

An investigation was conducted on a CDC 7600 digital computer to determine the effects of additional thickness distributions to the upper surface of the NACA 64-206 and 64 sub 1 - 212 airfoils The additional thickness distribution had the form of a continuous mathematical function which disappears at both the leading edge and the trailing edge The function behaves as a polynomial of order epsilon sub 1 at the leading edge and a polynomial of order epsilon sub 2 at the trailing edge Epsilon sub 2 is a constant and epsilon sub 1 is varied over a range of practical interest The magnitude of the additional thickness y is a second input parameter and the effect of varying epsilon sub 1 and y on the aerodynamic performance of the airfoil was investigated Results were obtained at a Mach number of 0 2 with an angle-of-attack of 6 degrees on the basic airfoils and all calculations employ the full potential flow equations for two dimensional flow The relaxation method of Jameson was employed for solution of the potential flow equations

Author

N75-24677*# North Carolina State Univ Raleigh
LIGHT AIRCRAFT LIFT, DRAG, AND MOMENT PREDICTION A REVIEW AND ANALYSIS
Frederick O Smetana Delbert C Summey Neill S Smith and Ronald K Carden Washington NASA May 1975 489 p refs
(Grant NGR-34-002-179)
(NASA-CR-2523) Avail NTIS HC $12 00 CSCL 01A

The historical development of analytical methods for predicting the lift drag and pitching moment of complete light aircraft configurations in cruising flight is reviewed Theoretical methods based in part on techniques described in the literature and in part on original work are developed These methods form the basis for understanding the computer programs given to (1) compute the lift, drag and moment of conventional airfoils (2) extend these two-dimensional characteristics to three dimensions for moderate-to-high aspect ratio unswept wings (3) plot complete configurations (4) convert the fuselage geometric data to the correct input format (5) compute the fuselage lift and drag (6) compute the lift and moment of symmetrical airfoils to M = 1 0 by a simplified semi-empirical procedure and (7) compute, in closed form the pressure distribution over a prolate spheroid at alpha = 0 Comparisons of the predictions with experiment indicate excellent lift and drag agreement for conventional airfoils and wings Limited comparisons of body-alone drag characteristics yield reasonable agreement Also included are discussions for interference effects and techniques for summing the results above to obtain predictions for complete configurations Author

N75-24678*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
LOW-SPEED AERODYNAMIC CHARACTERISTICS OF A 13-PERCENT THICK AIRFOIL SECTION DESIGNED FOR GENERAL AVIATION APPLICATIONS An Early Domestic Dissemination Report

Robert J McGhee William D Beasley, and Dan M Somers May 1975 57 p refs
(Proj FEDD)
(NASA-TM-X-72697) Avail NASA Industrial Applications Centers only to U S Requesters HC $4 25/MF $2 25 CSCL 01A

Wind-tunnel tests were conducted to determine the low-speed section characteristics of a 13-percent-thick airfoil designed for general aviation applications The results are compared with NACA 12-percent-thick sections and with the 17-percent-thick NASA airfoil The tests are conducted over a Mach number range from 0 10 to 0 35 Chord Reynolds numbers vary from about 2 million to 9 million

Author

N75-24680# Royal Aircraft Establishment Farnborough (England)
AN EXPERIMENTAL INVESTIGATION ON THE TRANSONIC FLUTTER CHARACTERISTICS OF THE CANTILEVER SWEPT-BACK WING WITH AEROFOIL SECTION, AND COMPARISON WITH THE THIN CANTILEVER SWEPT-BACK WING
T Morita E Nakai and T Kikuchi Mar 1975 21 p refs Transl into ENGLISH from the Japanese report NAL-TR-361 (RAE-Lib-Trans-1838 BR47558, NAL-TR-361) Avail NTIS HC $3 25

Transonic flutter characteristics of a cantilever swept-back wing at Mach numbers from 0 756 to 0 978 were studied in a 60cm x 60cm transonic blow-down wind tunnel for comparison with those of the thin cantilever swept-back wing The Reynolds numbers of the experiments were over about 1 million The two wing models used with and without a mass of engine pod attached had a streamwise airfoil section a sweep-back angle of 20 deg at the quarter-chord point and an aspect ratio and taper ratio of 8 and 0 4 respectively The boundaries of flutter density and experimental flutter-speed coefficients are characterized by minimum values at Mach numbers in the vicinity of 0 9 The flutter characteristics resemble those from previous tests of flat-plate cantilever swept-back wings It was found that the aerofoil section has a stabilizing effect except in the case of the wing with engine pod at the highest Mach numbers

Author

N75-24681*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va
ANALYSIS OF TRANSONIC FLOW ABOUT LIFTING WING-BODY CONFIGURATIONS
Richard W Barnwell Washington Jun 1975 73 p refs
(NASA-TR-R-440 L-9969) Avail NTIS HC $4 25 CSCL 01A

An analytical solution was obtained for the perturbation velocity potential for transonic flow about lifting wing-body configurations with order-one span-length ratios and small reduced-span-length ratios and equivalent-thickness-length ratios The analysis is performed with the method of matched asymptotic expansions The angles of attack which are considered are small but are large enough to insure that the effects of lift in the region far from the configuration are either dominant or comparable with the effects of thickness The modification to the equivalence rule which accounts for these lift effects is determined An analysis of transonic flow about lifting wings with large aspect ratios is also presented

Author

N75-24683# European Space Research Organization Paris (France)
DYNAMIC AND AEROELASTIC PROBLEMS OF STOP-ROTORS AND THEIR ANALYTICAL TREATMENT PART 2 ANALYTICAL EQUATIONS AND SOLUTIONS
H Foersching Mar 1975 82 p refs Transl into ENGLISH of 'Dynamische u aeroelastische Probleme des Stop-Rotors u ihre anal Behandlung Teil 2 Anal Ansaetze u Loesungsverfahren' DFVLR Goettingen, West Ger Report DLR-FB-73-19 1973 Original German report available from DFVLR Porz West Ger 17 40 DM
(ESRO-TT-145-Pt-2 DLR-FB-73-19) Avail NTIS HC $4 75

Based on previously derived relationships the appropriate equations and solutions are presented for the analytical treat-

ment of the dynamic and aeroelastic problems of stop-rotors of V/STOL aircraft In particular the problems of static torsional stability, flutter behavior, and gust loads on rotor blades occurring during the stop phase and during blade folding and retraction were investigated   Author (ESRO)

N75-24685# European Space Research Organization Paris (France)
INFLUENCE OF A PLAIN FLAP WITH A BLUNT, NOTCHED TRAILING EDGE ON THE LIFT OF A RECTANGULAR WING
M Tanner Mar 1975 20 p refs Transl into ENGLISH of "Einfluss einer Woelbungsklappe mit stumpfer gebrochener Hinterkante auf den Auftrieb eines Rechteckfluegels" DFVLR, Goettingen, West Ger Report DLR-FB-73-122, Oct 1973 Original German report available from DFVLR, Porz West Ger 9 DM
(ESRO-TT-147 DLR-FB-73-122) Avail NTIS HC $3 25
The influence of a plain flap with a blunt, notched trailing edge on the lift of a rectangular wing was investigated in a 3m wind tunnel The results show that for all the investigated flap angles from 0 to 45 deg the maximum lift coefficient is greater than for a wing with a sharp trailing edge while the flap efficiency coefficient is of approximately the same magnitude in both cases   Author (ESRO)

N75-24688# ARO Inc Arnold Air Force Station, Tenn
AN INVESTIGATION OF THE FLOW FIELD OF THE A-7D AIRCRAFT WITH SEVERAL EXTERNAL STORE LOADINGS AT MACH NUMBERS 0 70 AND 0 95 Final Report
J B Carman Jr Apr 1975 79 p refs Prepared in cooperation with Arnold Eng Develop Center
(AD-A008476 AEDC-TR-75-15 AFATL-TR-75-21) Avail NTIS CSCL 01/3
Wind tunnel tests were conducted using 0 05-scale models to study the flow field of the A-7D aircraft with several different external store load configurations The flow-angularity data were obtained at selected axial lateral and vertical positions under the inboard, center and outboard pylons of both wings of the aircraft Parent aircraft angles of attack were 2 6 and 10 deg at zero sideslip for free-stream Mach numbers of 0 70 and 0 95   GRA

N75-24689# Massachusetts Inst of Tech, Cambridge Aeroelastic and Structures Research Lab
SUMMARY OF MIT RESEARCH ON DYNAMIC STALL AND BLADE-VORTEX INTERACTION, 1971 - 1974
Norman D Ham Sep 1974 28 p refs
(Contract DA-31-124-ARO(D)-247)
(AD-A008091 ASRL-TR-130-4, ARO-4846-17-E) Avail NTIS CSCL 01/1
A previous MIT investigation indicated that during the close interaction of a vortex with a rotating blade, the measured vortex-induced unsteady loading on the blade differed greatly from that predicted by lifting-surface theory, both in peak magnitude and in chordwise distribution The experimental results suggested the occurrence of local separation in the region of most intense vortex-induced loading During the past year, blade-vortex interaction was studied by subjecting the midsection of a pressure-instrumented airfoil, mounted horizontally and perpendicular to the wind-tunnel airstream, to the impingement of a vortex moving periodically in the vertical plane from a point below the airfoil to a point above the airfoil and back again The results of this investigation have shown that the maximum vortex-induced lift coefficients are of the order of 0 2 to 0 3 The vortex-induced peak loadings were found to be independent of the frequency of vortex impingement (i e, vortex approach velocity) proportional to vortex strength and only weakly dependent upon airfoil angle of attack and angle of yaw   GRA

N75-24690# California Inst of Tech Pasadena Graduate Aeronautical Labs
TURBULENT WAKE BEHIND A SELF-PROPELLED BODY

Final Report, 1 Oct 1972 - 30 Sep 1973
Toshi Kubota 28 Mar 1975 39 p refs
(Contract DAHC04-72-C-0029)
(AD-A008417, GALCIT-138, ARO-10869 1-E) Avail NTIS CSCL 20/4
The wake behind a self-propelled body is studied for laminar and turbulent cases For the laminar wake, asymptotic solutions are obtained with and without swirl For the turbulent wake with the eddy-viscosity model the solution is obtained from the laminar flow solution by transformation that reduces the turbulent-flow equation to the equation for laminar flow With the mixing-length model for the turbulent shear stress, the far-wake solution becomes that of non-linear eigenvalue problem These two models yield results that do not agree with experimental results The far-wake solution is formulated based on a two-equation model for turbulent shear--turbulent energy and dissipation--with an additional assumption of negligible turbulence production from the mean flow   GRA

N75-24693# Army Missile Research, Development and Engineering Lab, Redstone Arsenal Ala Aeroballistics Directorate
THEORETICAL DOWNWASH VELOCITIES ABOUT THE AH-1G HELICOPTER AT HOVER AND 140 KNOTS
Alma S Marks 13 Dec 1974 161 p
(DA Proj 1M2-62303-A-214)
(AD-A008339 RD-75-21) Avail NTIS CSCL 01/3
Current programs in helicopter armament have not adequately treated the problem of the rocket or missile's response to the aircraft's downwash In this analysis, the downwash is represented as vortex filaments shed from the rotor tips, and the fuselage is represented by a source distribution The vehicle and flight data and the downwash velocity components for hover and forward flight cases are given   GRA

N75-24696*# United Air Lines Inc San Francisco Calif
THE OUT OF SERVICE GUEST PILOT EVALUATION OF THE TWO-SEGMENT NOISE ABATEMENT APPROACH IN THE BOEING B727-200
W E Nylen 30 Jan 1974 85 p
(Contract NAS2-7208)
(NASA-CR-137625) Avail NTIS HC $4 75 CSCL 20A
Guest pilot evaluation results of an approach profile modification for reducing ground level noise under the approach of jet aircraft runways are reported Evaluation results were used to develop a two segmented landing approach procedure and equipment necessary to obtain pilot airline, and FAA acceptance of the two segmented flight as a routine way of operating aircraft on approach and landing Data are given on pilot workload and acceptance of the procedure   E H W

N75-24698# Mitre Corp, McLean, Va
SAFETY-RELATED ENGINEERING AND DEVELOPMENT ACTIVITIES OF THE FEDERAL AVIATION ADMINISTRATION
Jerold M Chaukin and Marvin E Kay Mar 1975 112 p
(Contract DOT-FA70WA-2448)
(AD-A008395, M75-24, FAA-EM-75-2) Avail NTIS HC $5 25
The FAAs engineering and development (E&D) program directly related to the goal of improving air safety is defined Those safety-related E&D activities are categorized to correspond with associated categories of aviation accidents/fatalities Statistics on aircraft accidents/fatalities for the period January 1964 to December 1972 are presented for each category A summary description of each safety-related E&D activity is presented including the safety-related goals, current status and future plans Funding, by category, is presented for FY72-FY75   Author

N75-24699# Air Force Weapons Lab Kirtland AFB N Mex
A RADAR AND DIRECT VISUAL STUDY OF THE HAZARD TO AIRCRAFT FROM BIRD MIGRATIONS IN THE SOUTH-

WEST Final Report, 1 Apr 1972 - 31 Dec 1973
Robert C Beason Mar 1975 19 p refs
(AD-A008198) Avail NTIS CSCL 01/2

The increasing number of aircraft accidents caused by bird strikes while the aircraft is in flight is a concern of the Air Force The report concentrates on the danger during low-altitude high-speed missions as well as takeoffs and landings at a fixed base Methods for obtaining data are discussed with results from locations throughout the U S and the data are presented to show the concentrated areas where birds migrate Recommendations are made for a continuing study and methods for supplying flight-plan information that would avoid concentrated bird areas
GRA

N75-24701# National Transportation Safety Board, Washington, D C Bureau of Aviation Safety
PAN AMERICAN WORLD AIRWAYS, INCORPORATED, BOEING 707-321C, N458PA, BOSTON, MASSACHUSETTS, NOVEMBER 1973 Aircraft Accident Report
2 Dec 1974 120 p
(PB-239448/4, NTSB-AAR-74-16) Avail NTIS HC$5 25 CSCL 01B

The Boeing 707-321C (N458PA) crash at Logan International Airport Boston, Massachusetts was investigated Results indicate that the probable cause of the accident was the presence of smoke in the cockpit which was continuously generated and uncontrollable The smoke led to an emergency situation that culminated in loss of control of the aircraft during final approach when the crew in uncoordinated action deactivated the yaw damper in conjunction with incompatible positioning of flight spoilers and wing flaps It is explained that the spontaneous chemical reaction between leaking nitric acid improperly packaged and stowed, and the improper sawdust packing surrounding the acid's package initiated the accident sequence GRA

N75-24702# National Transportation Safety Board, Washington, D C Bureau of Aviation Safety
SIERRA PACIFIC AIRLINES, INCORPORATED CONVAIR 340/440, N4819C NEAR BISHOP, CALIFORNIA, 13 MARCH 1974 Aircraft Accident Report
10 Jan 1975 34 p
(PB-239511/9 NTSB-AAR-75-1) Avail NTIS HC $3 75 CSCL 01B

A Convair 340/440 crash near Bishop California was investigated The last recorded transmission from the flight indicated that the aircraft was climbing under visual flight rules The aircraft crashed into a foothill of the White Mountains The National Transportation Safety Board was unable to determine the probable cause of the accident nor the reason why the flightcrew did not maintain a safe distance from hazardous terrain during night visual flight conditions GRA

N75-24717*# Boeing Co Seattle Wash
ADVANCED BEADED AND TUBULAR STRUCTURAL PANELS VOLUME 2 FABRICATION
Max D Musgrove and Russell F Northrup [1974] 49 p refs
(Contract NAS1-10749)
(NASA-CR-132482) Avail NTIS HC $3 75 CSCL 01B

A study was conducted to exploit the efficiency of curved elements in the design of lightweight structural panels under combined loads of axial compression inplane shear, and bending A summary of the total program (analysis, fabrication and test) is presented in document NASA CR-2514 Detailed descriptions of the analysis effort and of the panel tests are contained in supplementary documents NASA CR-132460 and NASA-CR-132515 respectively Data are also given on the development of economical fabrication techniques to minimize the effects of fabrication limitations on optimum panel designs
Author

N75-24718*# General Dynamics/Convair San Diego Calif
COMPUTER PROGRAM TO ASSESS IMPACT OF FATIGUE AND FRACTURE CRITERIA ON WEIGHT AND COST OF TRANSPORT AIRCRAFT
C J Tanner G S Kruse, and B H Oman Jun 1975 109 p refs
(Contract NAS1-12506)
(NASA-CR-132648) Avail NTIS HC $5 25 CSCL 01C

A preliminary design analysis tool for rapidly performing trade-off studies involving fatigue, fracture, static strength, weight, and cost is presented Analysis subprograms were developed for fatigue life, crack growth life, and residual strength and linked to a structural synthesis module which in turn was integrated into a computer program The part definition module of a cost and weight analysis program was expanded to be compatible with the upgraded structural synthesis capability The resultant vehicle design and evaluation program is named VDEP-2 It is an accurate and useful tool for estimating purposes at the preliminary design stage of airframe development A sample case along with an explanation of program applications and input preparation is presented Author

N75-24719*# Lockheed-California Co Burbank
FLIGHT SERVICE EVALUATION OF PRD-49/EPOXY COMPOSITE PANELS IN WIDE-BODIED COMMERCIAL TRANSPORT AIRCRAFT Annual Flight Service Evaluation Report
John H Wooley Jul 1974 14 p
(Contract NAS1-11621)
(NASA-CR-132647 LR-26580) Avail NTIS HC $3 25

Fairing panels were fabricated to evaluate the fabrication characteristics and flight service performance of PRD-49 (Kevlar-49) a composite reinforcing material and to compare it with the fiberglass which is currently in use Panel configurations were selected to evaluate the PRD-49 with two resin matrix materials in sandwich and solid laminate construction Left and right hand versions of these configurations were installed on L-1011 s which will accumulate approximately 3000 flight hours per year per aircraft The direct substitution of PRD-49 for fiberglass produced a twenty-six percent weight reduction on the panel configurations Examination of these panels revealed that there was no visible difference between the PRD-49 and adjacent fiberglass panels Author

N75-24720*# National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif
NASA/ARMY XV-15 TILT ROTOR RESEARCH AIRCRAFT FAMILIARIZATION DOCUMENT
Jan 1975 105 p Prepared in cooperation with Army Air Mobility R and D Lab Moffett Field, Calif
(NASA-TM-X-62407 A-5870) Avail NTIS HC $5 25 CSCL 01C

The design features and general characteristics of the NASA/Army XV-15 tilt rotor research aircraft are described This aircraft was conceived as a proof-of-concept vehicle and a V/STOL research tool for integrated wind tunnel, flight-simulation and flight-test investigations Discussions of special design provisions and safety considerations necessary to perform these missions are included in this report In addition to predictions of aircraft and engine performance for the hover, helicopter and airplane flight modes, analytical estimates of the structural and dynamic limitations of the XV-15 are provided Author

N75-24721*# Foster-Miller Associates, Inc Waltham Mass
DYNAMIC HEAVE-PITCH ANALYSIS OF AIR CUSHION LANDING SYSTEMS
K M Captain A B Boghani and D N Wormley Washington NASA May 1975 200 p
(Contract NAS1-12403)
(NASA-CR-2530) Avail NTIS HC $7 00 CSCL 01B

A program to develop analytical tools for evaluating the dynamic performance of Air Cushion Landing Systems (ACLS) is described The heave (vertical) motion of the ACLS was analyzed and the analysis was extended to cover coupled heave-pitch motions The mathematical models developed are based on a fundamental analysis of the body dynamics and fluid mechanics of the aircraft-cushion-runway interaction The air source characteristics flow losses in the feeding ducts trunk and cushion

the effects of fluid compressibility, and dynamic trunk deflections, including ground contact are considered A computer program, based on the heave-pitch analysis was developed to simulate the dynamic behavior of an ACLS during landing impact and taxi over an irregular runway The program outputs include ACLS motions, loadings, pressures and flows as a function of time To illustrate program use three basic types of simulations were carried out The results provide an initial indication of ACLS performance during (1) a static drop (2) landing impact and (3) taxi over a runway irregularity   Author

N75-24722*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
LOW SPEED WIND TUNNEL TESTS ON A ONE-SEVENTH SCALE MODEL OF THE H 126 JET FLAP AIRCRAFT
Georgene H Laub Apr 1975 42 p refs Prepared in cooperation with Army Air Mobility R and D Lab Moffett Field, Calif
(NASA-TM-X-62433 A-6074) Avail NTIS HC $3 75 CSCL 01A

Low speed wind tunnel tests were performed on a one-seventh scale model of the British H 126 jet flap research aircraft over a range of jet momentum coefficients The primary objective was to compare model aerodynamic characteristics with those of the aircraft with the intent to provide preliminary data needed towards establishing small-to-full scale correlating techniques on jet flap V/STOL aircraft configurations Lift and drag coefficients from the model and aircraft tests were found to be in reasonable agreement The pitching moment coefficient and trim condition correlation was poor A secondary objective was to evaluate a modified thrust nozzle having thrust reversal capability The results showed there was a considerable loss of lift in the reverse thrust operational mode because of increased nozzle-wing flow interference A comparison between the model simulated H 126 wing jet efflux and the model uniform pressure distribution wing jet efflux indicated no more than 5% loss in weight flow rate   Author

N75-24723*# Techtran Corp Glen Burnie, Md
INCREASING THE WEAR RESISTANCE OF AIRCRAFT PARTS
K A Krylov Washington NASA Oct 1974 134 p refs Transl into ENGLISH of the book "Povysheniye iznosostoykosti detaley samoletov Moscow, Transport Press 1974 144 p (Contract NASw-2485)
(NASA-TT-F-15759) Avail NTIS HC $5 75 CSCL 01C

The reasons for the insufficient wear resistance of moving parts of bolt and hinge joints in aircraft are examined The results of investigations of the indicated aircraft parts are presented in connection with the occurrence of wear in their operation which is impermissible in amount and character In addition recommendations for increasing the wear resistance of parts are given   Author

N75-24724# Boeing Vertol Co Philadelphia Pa
HEAVY LIFT HELICOPTER, CARGO HANDLING ATC PROGRAM VOLUME 2 FABRICATION OF TEST HARDWARE AND FIXTURES INTEGRATED TEST RIG Final Report, Jun 1971 - Jun 1974
Joseph Shefrin and Wendell F Hill Dec 1974 218 p
(Contract DAAJ01-71-C-0840)
(AD-A007244 USAAMRDL-TR-74-97B-Vol-2) Avail NTIS CSCL 01/3

This report formally documents the efforts and results of the cargo handling system segment of the Heavy Lift Helicopter (HLH) Advanced Technology Component (ATC) development program The purpose of the HLH/ATC was to minimize technical cost and schedule risks associated with future HLH system research development test and evaluation (RDTE) and production programs This was achieved by design fabrication and testing of specific ATC hardware in three critical air vehicle subsystems rotor/drive system flight control system and cargo handling system This report covers only the cargo handling system   GRA

N75-24725# Aerospace Medical Research Labs Wright-Patterson AFB Ohio

ADVANCED MANEUVERABILITY OPTIONS FOR FUTURE FIGHTERS
Philip V Kulwicki and James M Sinnett Mar 1975 35 p refs Presented at the Avionics Sect Meeting Amer Defense Preparedness Assoc, Point Mugu Calif 20-21 Nov 1974 (AF Proj 7184)
(AD-A008497 AMRL-TR-74-140) Avail NTIS CSCL 01/3

Recent developments in fighter design technology have emphasized air combat maneuverability High thrust-to-weight ratio engines, advanced lightweight structures improved aerodynamic efficiencies and effective flight control systems developments enable realization of more responsive higher levels of air combat maneuverability than ever before seen in fighter aircraft Parallel developments in high acceleration and advanced cockpit technologies within the aeromedical and engineering communities have illuminated the ability to realize significant improvements in performance levels for future tactical fighters   GRA

N75-24726# Air Force Systems Command Wright-Patterson AFB Ohio Foreign Technology Div
TOTAL AIRFRAME FATIGUE TEST F 104 G Final Report
Schutz 20 Mar 1975 109 p Transl into ENGLISH from Ind Facilities Operations Corp (West Germany) no TF-81/20 15 Mar 1974 p 1-106
(AD-A007938 FTD-HC-23-0842-75) Avail NTIS CSCL 01/3

The report contains the most important information and data on the experimental configuration experimental sequence and the results of the F 104 G total airframe fatigue experiment Details are contained in 31 additional partial reports In addition the tables of Appendix B contain all the damage information which occurred on the structure during the experiments This report can be used as a means of orientation for the information contained in the partial reports because of the cross references in the text and the tables   GRA

N75-24727# United Aircraft Corp, Stratford Conn Sikorsky Aircraft Div
FLIGHT LOAD INVESTIGATION OF HELICOPTER EXTERNAL LOADS Final Report
Horace T Hone Feb 1975 75 p refs
(Contract DAAJ02-74-C-0016 DA Proj 1F2-62203-AH-86)
(AD-A008394 SER-50906, USAAMRDL-TR-74-104) Avail NTIS CSCL 01/3

Any cargo that is freely suspended from a helicopter fuselage, by any of several available methods, does not experience the same dynamic loads as the aircraft For various reasons the load factors may be amplified and peak out of phase with those of the helicopter This has long been suspected as a major contribution to premature failures in slings, pendants, and attachment points at the aircraft or cargo A theoretical analysis of the load factor relationship during various flight maneuvers was conducted by Sikorsky Aircraft in 1971 by means of a hybrid computer simulation of the coupled motion of a CH-54 helicopter and several types of external loads, conducted in real time and nonreal time on a fixed-base and a moving-base simulator Actual flight tests have now been performed on a CH-54 helicopter to investigate the validity of that part of the simulator program from which was derived the relationship between helicopter load factor and sling tension load factor   GRA

N75-24728# Air Force Aero Propulsion Lab, Wright-Patterson AFB, Ohio
FUEL TANK NON-NUCLEAR VULNERABILITY TEST PROGRAM Final Report, Jan 1973 - Feb 1974
Allan J Ferrenberg and Joel Blickenstaff Feb 1975 141 p refs
(Contract F33615-73-C-0473, AF Proj 3048)
(AD-A008531, AFAPL-TR-74-83) Avail NTIS CSCL 01/3

The effort described was designed to obtain weapons effects data on fuel tanks and their peripheral areas in support of an ASD non-nuclear survivability program Specifically, the objectives of this program were to obtain data to assist in determining (1) probabilities of fuel tank explosions, and (2) probabilities of fires in void areas adjacent to fuel tanks, caused by certain non-nuclear combat threats An additional objective was to

evaluate the effectiveness of the level of nitrogen inerting proposed for aircraft fuel tanks   GRA

N75-24729# Bolt Beranek, and Newman, Inc Cambridge Mass
GUIDE FOR THE DESIGN OF CONTROL STICKS IN VIBRATION ENVIRONMENTS Final Report
William H Levison and Philip D Houck Feb 1975 154 p refs
(Contract F33615-74-C-4041)
(AD-A008533, BBN-6863 AMRL-TR-74-127) Avail NTIS CSCL 01/3
A set of manual control experiments was conducted to determine the effects of control-stick parameters on tracking performance in a vibration environment Preliminary experimental variables were stick design parameters, stick location, and presence or absence of vibration Stick parameters had little effect on rms tracking error under vibration conditions for the particular aircraft dynamics that were used in this study Considerable effect on control activity was observed however which suggests that stick design parameters will significantly influence overall performance in systems that respond at vibration frequencies Stick lokation had no significant effect on either tracking or biodynamic performance measures   GRA

N75-24730# Boeing Commercial Airplane Co , Seattle, Wash
TEST AND PERFORMANCE CRITERIA FOR AIRPLANE ANTISKID SYSTEMS Final Report, Dec 1972 - Jun 1974
H H Straub, N S Attri, and R F Yurczyk Oct 1974 21 p
(Contract F33615-73-C-3017 AF Proj 1369)
(AD-A008536, AFFDL-TR-74-118) Avail NTIS CSCL 01/2
The basic components and operation of airplane antiskid systems are described Test and performance criteria are established on a system as well as component level to support the development of a new brake control system These criteria are established for the analog-hardware simulator the dynamometer and full airplane tests   GRA

N75-24731# Kamatics Corp , Bloomfield, Conn
KAFLEX DRIVE SHAFT COUPLING FOR UH-1 HELICOPTER DESIGN REFINEMENT Final Technical Report
Charles J Wirth 1975 68 p refs
(Contract DAAJ01-72-C-0900)
(AD-A008365, KC-11174 USAAVSCOM-TR-74-76) Avail NTIS CSCL 01/3
A KA flex coupling shaft, using flexing metal elements to accommodate misalignment has been designed as a replacement for the main drive shaft coupling of the UH-1 helicopter Previous program phases explored the feasibility of this approach through analysis and test of a prototype coupling shaft The program phases covered in this report include an examination of compatibility of the coupling shaft to the space envelope and operating conditions encountered in the UH-1 installation, and refinement of the prototype design to reflect the results of this and previous examinations A mock up installation of the prototype coupling shaft is made clearances are evaluated and lateral natural frequencies are measured and verified through analysis   GRA

N75-24732# Pisa Univ (Italy) Inst of Aeronautics
THEORETICAL AND EXPERIMENTAL RESEARCH ON THE FATIGUE CRACK PROPAGATION IN STIFFENED PANELS, AN EVALUATION OF THE PARIS THEORY Final Technical Report
A Salvetti A Frediani E Grassi and F Rossi Sep 1974 83 p refs
(Contract DAJA37-73-C-2881)
(AD-A008079) Avail NTIS CSCL 01/3
Research on the applicability of the Paris theory to aircraft riveted stiffened structures is reported This research was carried out in two stages evaluation of the stress intensity factor K in stiffened panels and measurement of crack growth rate in stiffened and unstiffened panels   GRA

N75-24733# LTV Aerospace Corp Dallas, Tex Vought Systems Div

SAFEZONE ESCAPE ALERT SYSTEM DEVELOPMENT PROGRAM PHASE 1 SYSTEM DEVELOPMENT
E O Cartwright 3 Mar 1975 68 p refs
(Contract N62269-74-C-0523)
(AD-A008561 NADC-Cs-75029-40 Rept-2-57110/4R-3191) Avail NTIS CSCL 01/3
A program was conducted to establish the basic value of a system designed to provide the aircrewman of an escape system equipped aircraft with a continuous indication of inflight escape capability The system, as conceived monitors aircraft dynamic conditions such as altitude sink rate and attitude, and provides this data to an onboard computer Continuous computations are made and the results displayed to the aircrewman Simulated flight envelopes were flown in a G degree-of-freedom moving base simulator This included spin attack and flameout approach simulation Two display concepts were evaluated a digital read out of time remaining and an analog display with time remaining and rate of change displayed Pilot performance was measured and pilot opinion was registered   GRA

N75-24734# Naval Surface Weapons Center, Dahlgren, Va
AN ESTIMATE OF THE EFFECT OF MULTIPLE EJECTION RACK FLEXIBILITY ON SIX DEGREE OF FREEDOM STORE EJECTION CONDITIONS
Leroy Devan Mar 1975 50 p refs
(AD-A008329 NSWC/DL-TR-3252) Avail NTIS CSCL 01/3
A theoretical structural dynamic model of a MER (Multiple Ejection Rack) based upon BERNOULLI Pitch and yaw bending deflections and torsional rotation, is developed Six-degree-of-freedom store ejection conditions are predicted Sample computations were made for a M-117 bomb and constant aircraft pull-up rates corresponding to up to a 3 9 g normal acceleration The computations were for the second fourth, and sixth bombs dropped in the normal release sequence from an A-7D right wing center pylon station Ejection velocities computed do not deviate more than 15% from the rigid case Ejection pitching and rolling rates are affected more significantly by flexibility However, the pull-up maneuver alone affects the ejection conditions to a greater extent than flexibility for most ejection variables and g values greater than 2   GRA

N75-24735*# Decision Sciences Corp Jenkintown, Pa
ANALYSIS OF TECHNOLOGY REQUIREMENTS AND POTENTIAL DEMAND FOR GENERAL AVIATION AVIONICS SYSTEMS IN THE 1980'S Final Report
David M Cohn John H Kayser George M Senko, and Donald R Glenn Jun 1974 223 p refs
(Contract NAS2-7888)
(NASA-CR-137629) Avail NTIS HC $7 25 CSCL 01C
The trend for the increasing need for aircraft-in-general as a major source of transportation in the United States is presented (military and commercial aircraft are excluded) Social, political, and economic factors that affect the aircraft industry are considered and cost estimates are given Aircraft equipment and navigation systems are discussed   J R T

N75-24736* National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif
REVERSED COWL FLAP INLET THRUST AUGMENTOR Patent
Dah Yu Cheng, inventor (to NASA) (Santa Clara Univ) Issued 13 May 1975 7 p Filed 19 Sep 1973 Supersedes N73-32624 (11 - 23, p 2831) Sponsored by NASA
(NASA-Case-ARC-10754-1 US-Patent-3,883,095,
US-Patent-Appl-SN-398886 US-Patent-Class-244-53B,
US-Patent-Class-137-15 1) Avail US Patent Office CSCL 21E
An adjustable airfoil is described for varying the geometry of a jet inlet and an ejector inlet in a jet engine for providing thrust augmentation and noise reduction The airfoil comprises essentially a plurality of segments which are extended radially outward and retracted relative to the longitudinal axis of the engine as a function of a change in the pressure differential between the upstream and downstream surfaces of the airfoil

A servo mechanism responsive to the change in the pressure differential is coupled to the airfoil to extend and retract the airfoil segments to maintain the pressure at a maximum on the downstream side of the airfoil relative to the pressure on the upstream side of the airfoil At low speeds such as at take-offs and landings the airfoil is fully extended while at high speeds it is fully retracted   Official Gazette of the U S Patent Office

N75-24737*# Boeing Commercial Airplane Co Seattle Wash
THE 727 AIRPLANE TARGET THRUST REVERSER STATIC PERFORMANCE MODEL TEST FOR REFANNED JT8D ENGINES
C T P Chow and E N Atkey Jul 1974 195 p refs
(Contract NAS3-17842)
(NASA-CR-134652 Dg-41964) Avail NTIS HC $7 00 CSCL 21E

The results of a scale model static performance test of target thrust reverser configurations for the Pratt and Whitney Aircraft JT8D-100 series engine are presented The objective of the test was to select a series of suitable candidate reverser configurations for the subsequent airplane model wind tunnel ingestion and flight controls tests Test results indicate that adequate reverse thrust performance with compatible engine airflow match is achievable for the selected configurations Tapering of the lips results in loss of performance and only minimal flow directivity Door pressure surveys were conducted on a selected number of lip and fence configurations to obtain data to support the design of the thrust reverser system   Author

N75-24738*# AiResearch Mfg Co Torrance, Calif
HYPERSONIC RESEARCH ENGINE PROJECT PHASE 2 SOME COMBUSTOR TEST RESULTS OF NASA AEROTHERMODYNAMIC INTEGRATION MODEL
Yung H Sun Albert E Gaede, and Walter C Saimo May 1975 26 p refs Presented at the 11th JANNAF Combustion Conf, Pasadena, Calif, 12 Sep 1974
(Contract NAS1-6666)
(NASA-CR-132525 AiResearch-74-10818) Avail NTIS HC $3 75 CSCL 21E

Combustor test results of the NASA Aerothermodynamic Integration Model are presented of a ramjet engine developed for operation between Mach 3 and 8 Ground-based and flight experiments which provide the data required to advance the technology of hypersonic air-breathing propulsion systems as well as to evaluate facility and testing techniques are described The engine was tested with synthetic air at Mach 5 6 and 7 The hydrogen fuel was heated to 1500 R prior to injection to simulate a regeneratively cooled system Combustor efficiencies up to 95 percent at Mach 6 were achieved Combustor process in terms of effectiveness pressure integral factor total pressure recovery and Crocco s pressure-area relationship are presented and discussed Interactions between inlet-combustor combustor stages combustor-nozzle and the effects of altitude combustor step, and struts are observed and analyzed   Author

N75-24739*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
PRELIMINARY STUDY OF ADVANCED TURBOPROPS FOR LOW ENERGY CONSUMPTION
G Kraft and W Strack May 1975 48 p refs
(NASA-TM-X-71740 E-8371) Avail NTIS HC $3 75 CSCL 21E

The fuel savings potential of advanced turboprops (operational about 1985) was calculated and compared with that of an advanced turbofan for use in an advanced subsonic transport At the design point altitude 10 67 km and Mach 0 80 turbine-inlet temperature was fixed at 1590 K while overall pressure ratio was varied from 25 to 50 The regenerative turboprop had a pressure ratio of only 10 and an 85 percent effective rotary heat exchanger Variable camber propellers were used with an efficiency of 85 percent The study indicated a fuel savings of 33 percent a takeoff gross weight reduction of 15 percent and a direct operating cost reduction of 18 percent was possible when turboprops were used instead of the reference turbofan at a range of 10 200 km These reductions were 28 11 and 14 percent respectively at a range of 5500 km Increasing

overall pressure ratio from 25 to 50 saved little fuel and slightly increased takeoff gross weight   Author

N75-24740*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
FLOW CHARACTERISTICS OF VARIOUS SWIRL-CAN MODULE DESIGNS
Edward J Mularz Washington Jun 1975 39 p refs Prepared in cooperation Army Air Mobility Research and Development Lab, Cleveland Ohio
(NASA-TM-X-3236 E-8190) Avail NTIS HC $3 75 CSCL 21E

Flow measurements were performed on each of six swirl-can combustor module designs under simulated combustor operating conditions to find the design which exhibited a small recirculation zone intense air mixing and good fuel distribution in its wake Conditions that are favorable for producing low oxides of nitrogen emissions and high combustion efficiency were investigated The recirculation zone the turbulence intensity and the fuel distribution pattern are obtained in the wake region of the center module of a three module array The most promising swirl-can module design incorporates two air swirlers which discharge air in opposite directions (contraswirl) mixes the fuel and air upstream of the inner swirler and has a flow area blockage of 64 3% for the three module array   Author

N75-24741*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio
TURBINE DESIGN AND APPLICATION, VOLUME 3
Arthur J Glassman ed Washington 1975 141 p refs
(NASA-SP-290-Vol-3, LC-79-185105) Avail NTIS MF $2 25 SOD HC $2 10 CSCL 21E

Turbine technology concepts for thermodynamic and fluid dynamics are presented along with velocity diagrams losses, mechanical design operation and performance Designs discussed include supersonic turbines radial-inflow turbines and turbine cooling   F O S

N75-24742*# AiResearch Mfg Co Torrance, Calif
HYPERSONIC RESEARCH ENGINE PROJECT, PHASE 2 PRELIMINARY REPORT ON THE PERFORMANCE OF THE HRE/AIM AT MACH 6
Yung H Sun and Walter C Saimo May 1975 26 p refs
(Contract NAS1-6666)
(NASA-CR-132538 AiResearch-74-10951) Avail NTIS HC $3 75 CSCL 21E

Test results of the Aerothermodynamic Integration Model are presented A program was initiated to develop a hydrogen-fueled research-oriented scramjet for operation between Mach 3 and 8 The primary objectives were to investigate the internal aerothermodynamic characteristics of the engine to provide realistic design parameters for future hypersonic engine development as well as to evaluate the ground test facility and testing techniques The engine was tested at the NASA hypersonic tunnel facility with synthetic air at Mach 5 6 and 7 The hydrogen fuel was heated up to 1500 R prior to injection to simulate a regeneratively cooled system The engine and component performance at Mach 6 is reported Inlet performance compared very well both with theory and with subscale model tests Combustor efficiencies up to 95 percent were attained at an equivalence ratio of unity Nozzle performance was lower than expected The overall engine performance was computed using two different methods The performance was also compared with test data from other sources   Author

N75-24743*# AiResearch Mfg Co Los Angeles Calif
HYPERSONIC RESEARCH ENGINE PROJECT PHASE 2A INSTRUMENTATION PROGRAM Interim Technical Report, 24 Aug - 23 Nov 1967
P M Parmar, ed May 1975 75 p refs
(Contract NAS1-6666)
(NASA-CR-132593, AP-67-3020 ITR-3) Avail NTIS CSCL 21E

Instrumentation developments are reported for thrust measurement gas sampling, temperature measurement pressure measurement and systems engineering   Author

N75-24744*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
VIBRATION RESPONSES OF TEST STRUCTURE NO 1 DURING THE EDWARDS AIR FORCE BASE PHASE OF THE NATIONAL SONIC BOOM PROGRAM
Donald S Findley, Vera Huckel and Herbert R Henderson Jun 1975 28 p ref
(NASA-TM-X-72706) Avail NTIS HC $3 75 CSCL 13B

In order to evaluate reaction of people to sonic booms of varying overpressures and time durations a series of closely controlled and systematic flight test studies were conducted in the vicinity of Edwards AFB California, from June 3 to June 23 1966 The dynamic responses of several building structures were measured as a part of these studies and the measurements made in a one-story residence structure (Edwards test structure No 1) are presented Sample acceleration and strain recordings are presented from F-104 B-58, and XB-70 sonic-boom exposures along with tabulations of the maximum acceleration and strain values measured for each one of about 140 flight tests These data are compared with similar measurements for engine noise exposures of the building during simulated landing approaches and takeoffs of KC-135 aircraft   Author

N75-24745*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
EFFECT ON FAN FLOW CHARACTERISTICS OF LENGTH AND AXIAL LOCATION OF A CASCADE THRUST REVERSER
Donald A Dietrich Washington Jun 1975 37 p refs
(NASA-TM-X-3247, E-8223) Avail NTIS HC $3 75 CSCL 21E

A series of static tests were conducted on a model fan with a diameter of 14 0 cm to determine the fan operating characteristics the inlet static pressure contours the fan-exit total and static pressure contours and the fan-exit pressure distortion parameters associated with the installation of a partial-circumferential-emission cascade thrust reverser The tests variables included the cascade axial length the axial location of the reverser and the type of fan inlet It was shown that significant total and static pressure distortions were produced in the fan aft duct and that some configurations induced a static pressure distortion at the fan face The amount of flow passed by the fan and the level of the flow distortions were dependent upon all the variables tested   Author

N75-24746*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
EXHAUST POLLUTANT EMISSIONS FROM SWIRL-CAN COMBUSTOR MODULE ARRAYS AT PARAMETRIC TEST CONDITIONS
Edward J Mularz Jerrold D Wear and Peter W Verbulecz Washington Jun 1975 33 p refs Prepared in cooperation with Army Air Mobility R and D Lab Cleveland Ohio
(NASA-TM-X-3237 E-8196) Avail NTIS HC $3 75 CSCL 21E

Improved designs of swirl-can combustor modules were tested using seven-module arrays in a combustor The combustor was operated over a pressure range of 69 to 207 N/sq cm a fuel-air ratio range of 0 015 to 0 046 at a constant inlet air temperature of 733 K and at reference velocities of 23 9 and 30 6 m/sec The three designs tested performed with high combustion efficiency at all conditions tested and exhibited oxides of nitrogen emissions substantially lower than that of conventional gas turbine combustors A correlating parameter used to extrapolate oxides of nitrogen emissions to full power or takeoff conditions for large commercial turbofan engines predicts oxides of nitrogen emissions somewhat higher than those specified in the 1979 government emissions standards   Author

N75-24747*# TRW Equipment Labs Cleveland Ohio
DEVELOPMENT OF IMPACT RESISTANT BORON/

ALUMINUM COMPOSITES FOR TURBOJET ENGINE FAN BLADES
P Melnyk and I J Toth May 1975 93 p
(Contract NAS3-17763)
(NASA-CR-134770, ER-7806) Avail NTIS HC $4 75 CSCL 21E

Composite fabrication was performed by vacuum press diffusion bonding by both the foil-filament array and preconsolidated monotape methods The effect of matrix material fiber diameter, matrix enhancement fiber volume reinforcement test temperature angle-plying, notch, impact orientation processing variables and fabrication methods on tensile strength and Charpy impact resistance are evaluated Root attachment concepts were evaluated by room and elevated temperature tensile testing, as well as by pendulum-Izod and ballistic impact testing Composite resistance to foreign object damage was also evaluated by ballistic impacting of panels using projectiles of gelatin, RTV rubber and steel at various velocities, and impingement angles A significant improvement in the pendulum impact resistance of B-Al composites was achieved   Author

N75-24754# Honeywell Inc Minneapolis Minn   Government and Aeronautical Products Div
DIGITAL FLIGHT CONTROL SYSTEMS FOR TACTICAL FIGHTERS VOLUME 3 DIGITAL FLIGHT CONTROL SYSTEM DESIGN CONSIDERATION Interim Report, Feb 1972 - Jun 1973
M A Bender, R J Gaabo, and F L Smith Jun 1974 436 p
(Contract F33615-72-C-1058 AF Proj 1987)
(AD-A002687 GAPD-F-0131-IR3, AFFDL-TR-73-119-Vol-3) Avail NTIS CSCL 01/4

The Digital Flight Control Systems for Tactical Fighters Program is a development program the objective of which is to define the technology necessary to apply digital flight control techniques to the three-axis multiple flight control configuration demands of advanced fighter aircraft Analysis efforts have defined powerful analytical DF CS models and computer program tools which permit determination of flight control system performance as a function of computational parameters -- word length, sample rate and computational delays An exercise of the programs using the F-4 as a model indicated 100 iterations per second as satisfactory for the longitudinal axis   GRA

N75-24755# Cranfield Inst of Technology (England)
ON THE ADEQUATE MODEL FOR AIRCRAFT PARAMETER ESTIMATION
V Klein Mar 1975 33 p refs
(Cranfield-Aero-28) Avail NTIS HC $3 75

The problem of the selection of measured data from an aircraft of an adequate model which approximates the correct model and which facilitates the successful determination of unknown parameters is presented Two ways for the proper model structure verification are recommended, namely sensitivity analysis and/or testing of a hypothesis as to the significance of unknown parameters in the model proposed and the analysis of residuals Some approaches towards the assessment of parameter and adequate model accuracies are proposed and an example is shown   Author

N75-24756*# Stanford Univ, Calif
EFFECTS OF ASYMMETRY ON THE DYNAMIC STABILITY OF AIRCRAFT Final Technical Report
R E Fantino E K Parsons, J D Powell, and R S Shevell Jun 1975 259 p refs
(Grant NGR-05-020-663)
(NASA-CR-142857) Avail NTIS HC $8 50 CSCL 01C

The oblique wing concept for transonic aircraft was proposed to reduce drag The dynamic stability of the aircraft was investigated by analytically determining the stability derivatives at angles of skew ranging from 0 and 45 deg and using these stability derivatives in a linear analysis of the coupled aircraft behavior The stability derivatives were obtained using a lifting line aerodynamic theory and found to give reasonable agreement with derivatives developed in a previous study for the same

aircraft In the dynamic analysis no instability or large changes occurred in the root locations for skew angles varying from 0 to 45 deg with the exception of roll convergence The damping in roll however decreased by an order of magnitude Rolling was a prominent feature of all the oscillatory mode shapes at high skew angles   Author

N75-24757# Honeywell Inc, Minneapolis, Minn   Systems and Research Center
DIGITAL FLIGHT CONTROL SYSTEM FOR TACTICAL FIGHTERS Final Report, Feb 1972 - Dec 1973
A Ferit Konar Robert J Gaabo Marv A Bender, Fred L Smith and James D Wolf Jul 1974 424 p
(Contract F33615-72-C-1058 AF Proj 1987)
(AD-A002686 F0121-IR1 AFFDL-TR-74-69) Avail NTIS CSCL 01/3
The Digital Flight Control Systems for Tactical Fighters Program is a development program the objective of which is to define the technology necessary to apply digital flight control techniques to the three-axis multiple flight control configuration demands of advanced fighter aircraft Analysis efforts have defined powerful analytical DF CS models and computer program tools which permit determination of flight control system performance as a function of computational parameters -- word length sample rate and computational delays An exercise of the programs using the F-4 as a model indicated 100 iterations per second as satisfactory for the longitudinal axis
                                                                  GRA

N75-24760*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
SHUTTLE SPACELAB SIMULATION USING A LEAR JET AIRCRAFT MISSION NO 3 (ASSESS PROGRAM)
John O Reller, Jr, Carr B Neel, and Robert H Mason Nov 1974 145 p refs
(NASA-TM-X-62410 A-5907) Avail NTIS HC $5 75 CSCL 14B
The third ASSESS mission using a Lear Jet aircraft conducted to continue the study of scientific experiment operations in a simulated Spacelab environment Prior to the mission research planning and equipment preparation were observed and documented A flight readiness review for the experiment was conducted Nine of the ten scheduled flights were completed during simulation mission and all major science objectives were accomplished The equipment was well qualified for flight and gave little trouble, telescope malfunctions occurred early in the mission and were corrected Both real-time and post-observation data evaluation were used to assess research progress and to plan subsequent flight observations for maximum effectiveness   Author

N75-24771# Wyle Labs, Inc El Segundo Calif
AIRPORT NOISE REDUCTION FORECAST   VOLUME 1 SUMMARY REPORT FOR 23 AIRPORTS Final Report, Jul 1972 - Oct 1974
Carroll Bartel, Louis C Sutherland, and Leroy Simpson Oct 1974 253 p refs Prepared in cooperation with Speas (R Dixon) Assoc , Manhasset, N Y
(Contract DOT-OS-20088)
(PB-239387/4 WRC-74-14-1) Avail NTIS HC $8 00 HC also available from NTIS $14 00/set of 2 reports as PB-239386-SET CSCL 01E
A detailed analysis of cost effectiveness of two aircraft noise reduction alternatives was carried out and the results are summarized The alternatives consisted of two different modifications of civil air carrier aircraft having JT3D or JT8D engines Both alternatives assumed standard use of a two-segment approach procedure incorporating a glide slope for landing The analysis specified includes a detailed evaluation of noise impact at 23 airports for the years 1972, 1978 1981, and 1987 along with a detailed cost analysis of implementing the alternatives
                                                                  GRA

N75-24772# Wyle Labs Inc El Segundo Calif
AIRPORT NOISE REDUCTION FORECAST   VOLUME 2 NEF COMPUTER PROGRAM DESCRIPTION AND USER'S MANUAL Final Report, Jul 1972 - Oct 1974

Carroll Bartel Charles Coughlin John Moran and Larry Watkins Oct 1974 229 p refs
(Contract DOT-OS-20088)
(PB-239388/2 WRC-74-14-2 DOT-TST-75-4) Avail NTIS HC $7 50 HC also available from NTIS $14 00/set of 2 reports as PB-239386 CSCL 01E
A fundamental requirement of this effort was that the noise impact of air traffic around major airports on the surrounding community should be described and that predictions of various noise abatement alternatives should be made For this the DOT/Wyle noise exposure forecast computer program was developed Volume 2 of the report is a description of this program Included are brief descriptions of the calculations performed the subroutines that perform them and a user s guide Also included is a complete listing of the program, in FORTRAN V Inputs to the program are a description of the airport geometry including flight paths, aircraft noise and performance characteristics and the aircraft fleet mix   GRA

N75-24897*# Tyco Labs Inc Waltham, Mass
DIRECTIONALLY SOLIDIFIED LAMELLAR EUTECTIC SUPERALLOYS BY EDGE-DEFINED, FILM-FED GROWTH Final Report
G F Hurlev Apr 1975 53 p refs
(Contract NAS3-18909)
(NASA-CR-134808) Avail NTIS HC $4 25 CSCL 11F
A program was performed to scale up the edge-defined, film-fed growth (EFG) method for the gamma/gamma prime-beta eutectic alloy of the nominal composition Ni-19 7 Cb - 6 Cr-2 5 Al Procedures and problem areas are described Flat bars approximately 12 x 1 7 x 200 mm were grown mostly at speeds of 38 mm/hr and tensile tests on these bars at 25 and 1000 C showed lower strength than expected The feasibility of growing hollow airfoils was also demonstrated by growing bars over 200 mm long with a teardrop shaped cross-section, having a major dimension of 12 mm and a maximum width of 5 mm
                                                                  Author

N75-24923# McDonnell Aircraft Co St Louis, Mo
EVALUATION OF THE RELIABILITY AND SENSITIVITY OF NDT METHODS FOR TITANIUM ALLOYS, VOLUME 2 Final Report, 1 May 1972 - 31 Jan 1974
Robert J Lord Jun 1974 373 p refs
(Contract F33615-72-C-1203 AF Proj 7351)
(AD-A001604, AFML-TR-73-107-Vol-2) Avail NTIS CSCL 11/6
The report describes the work conducted on a program designed to improve nondestructive testing techniques and then to evaluate the capability and reproducibility of the improved nondestructive testing techniques for the evaluation of discontinuities occurring in titanium Reported are penetrant dwell times penetrant bleed-out times developer types, emulsification times, and water washing parameters required to effectively penetrant inspect parts which may contain a variety of crack sizes and porosity Both post-emulsifiable and water washable fluorescent penetrants were investigated   The effect of kilovoltage on radiographic contrast sensitivity is discussed Ultrasonic inspection of contour surfaces is reported and methods for improving near-surface resolution are documented Methods for ultrasonic inspection of thin machined parts are reported   GRA

N75-24926#   Pratt and Whitney Aircraft, West Palm Beach, Fla
PROCESS EVALUATION OF DIRECTIONALLY SOLIDIFIED NI3CB REINFORCED EUTECTICS IN TURBINE BLADE FORM Final Report, 16 Mar 1974 - 15 Mar 1975
P M Curran, L F Schulmeister J S Erickson, and A F Giamei 15 Mar 1975 106 p refs
(Contract N00019-74-C-0194)
(AD-A008435, PWA-5231) Avail NTIS CSCL 21/5
The purpose of the program was to investigate the unidirectional solidification of delta (Ni3Cb) reinforced eutectic alloys in turbine blade form The liquid metal cooling (LMC) process, served as the basic processing technique for this investigation The major objectives of the program were to   (1) evaluate solidification

process modifications to increase the temperature gradient capability of the liquid metal cooling process (2) investigate the effect of solidification conditions on the microstructure and mechanical behavior of delta (Ni3Cb) reinforced eutectic alloys solidified in turbine blade form and (3) evaluate the solidification characteristics associated with the fabrication of (air-cooled) eutectic turbine blade airfoils   GRA

N75-25057*# West Virginia Univ Morgantown   Dept of Electrical Engineering
ANALYSIS AND DESIGN OF AIRCRAFT ANTENNAS Final Report, 1 Mar 1971 - 30 Jun 1975
Constantine A Balanis 30 Jun 1975 24 p
(Contract NGR-49-001-049)
(NASA-CR-142945) Avail NTIS HC $3 25 CSCL 09C
   Recording systems and other associated electronic equipment were engineered calibrated and used to measure antenna radiation patterns of aircraft structures Antenna design measured and computed results and performance are discussed Data show measured and computer data to be in agreement   E H W

N75-25094*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
EXTERNAL FINS AND EJECTOR ACTION FOR REDUCING THE INFRARED EMISSION OF ENGINE EXHAUST DUCT-ING
G James VanFossen Jr Washington Jun 1975 14 p refs
(NASA-TM-X-3242 E-8238) Avail NTIS HC $3 25 CSCL 20M
   An analytical investigation was conducted to determine the feasibility of using external fins and ejector action on the exhaust ducting of a helicopter to reduce the infrared emission of the aircraft Temperatures were calculated for both circular disk fins and pin fins Results show that combining ejector action with fins can lower the metal temperature to acceptable levels at least for high flight speeds   Author

N75-25221*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
CRACK GROWTH UNDER SPECTRUM LOADING   A CRACK CLOSURE MODEL
Wolf Elber [1975] 23 p refs Presented at the Symp of Fatigue Crack Growth Under Spectrum Loading 78th Ann ASTM Meeting
(NASA-TM-X-72708) Avail NTIS HC $3 25 CSCL 20K
   A concept based on the crack-closure phenomenon was developed to replace random load spectra with constant amplitude loading in both analysis and tests The maximum load and the crack opening load in the constant amplitude loading are chosen to be equal to those for the spectrum so that both crack growth mode and the crack length at failure are equivalent to those under random load spectra The number of cycles of constant-amplitude loading is chosen so that the amount of crack growth is equal to that due to a given sequence or block of the random spectrum loading The concept was tested experimentally after predicting the equivalent number of constant-amplitude cycles for six different random load sequences The agreement between predictions and test results was good   Author

N75-25298*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
CHALLENGE TO AVIATION   HATCHING A LEANER PTEROSAUER
Frank E Moss 1975 9 p Presented at Aeron Propulsion Conf Cleveland, 13 May 1975
(NASA-TM-X-71744) Avail NTIS HC $3 25 CSCL 10B
   Modifications in commercial aircraft design particularly the development of lighter aircraft are discussed as effective means of reducing aviation fuel consumption The modifications outlined include (1) use of the supercritical wing, (2) generation of the winglet, (3) production and flight testing of composite materials, and, (4) implementation of fly-by-wire control systems Attention is also given to engineering laminar air flow control, improving cargo payloads and adapting hydrogen fuels for aircraft use
                          L B

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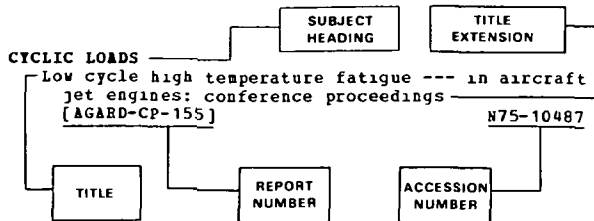
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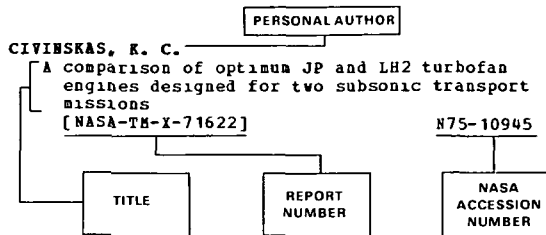
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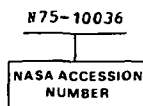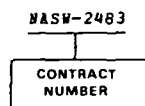   [ASME PAPER 75-GT-40]   A75-34597
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